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Model Engineer

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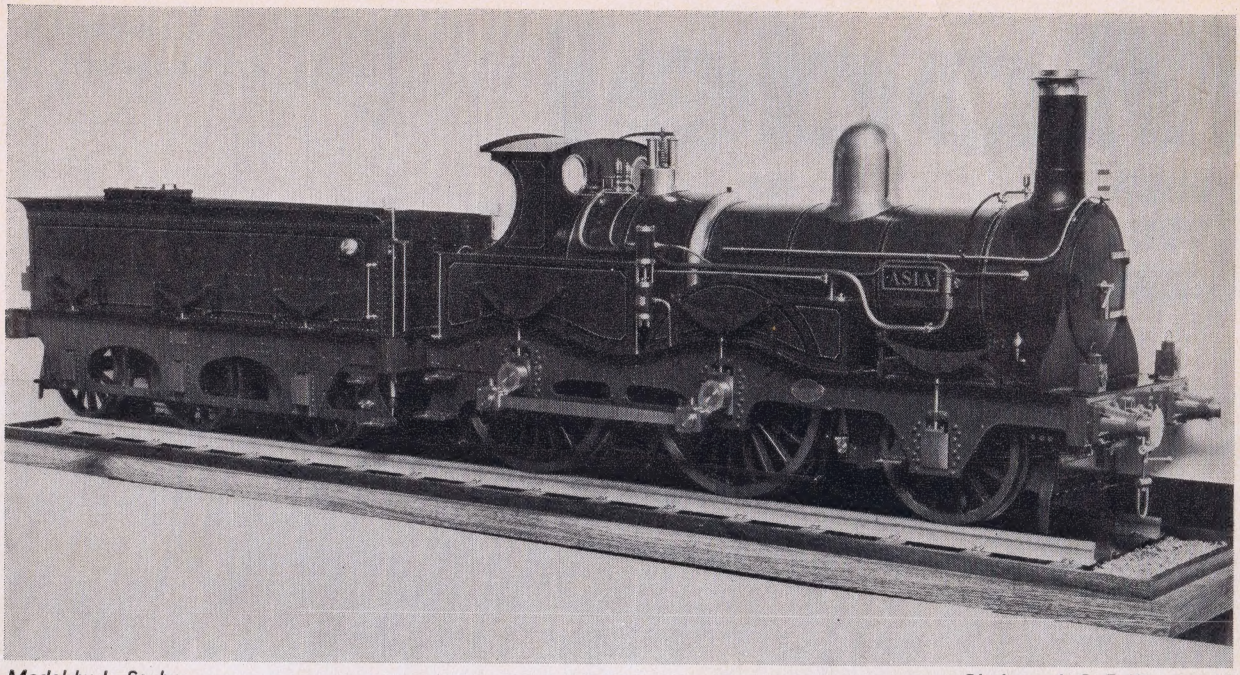

Model by L. Saxby *Photograph G. F. Woodworth*

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Volume 142 Number 3545

17 September 1976

CONTENTS

Smoke Rings: notes by the Editor	893
Building a Williamson engine	894
Model Marshall portable engine	898
Australian locomotive trials	902
Rubber tyres for model road vehicles	906
A plug-in spindle	908
Southern Belle: Gauge I "Atlantic" locomotive	909
The hot air engine competition	914
New track at King's Lynn	918
The Guildford Rally	919
A 7¼ in. track in Devon	922
News from the Clubs	924
Jeynes' Corner	925
Postbag: letters to the Editor	926

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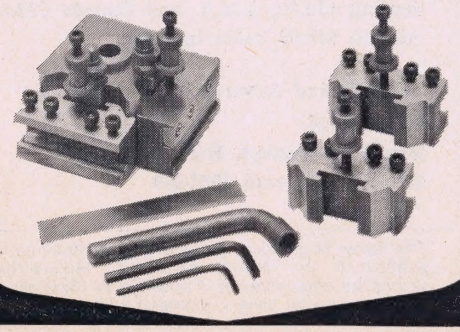

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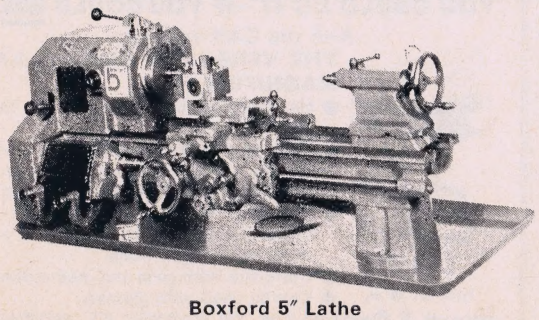

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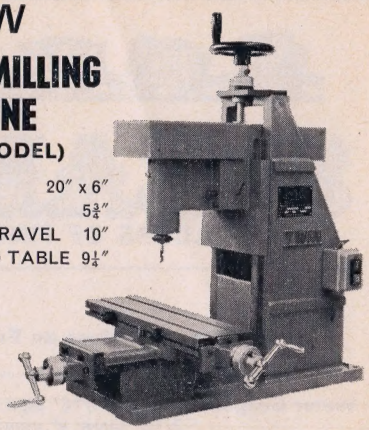

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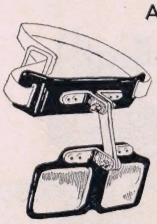

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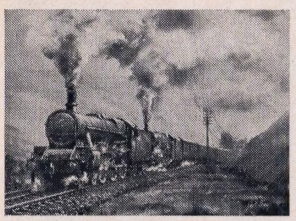

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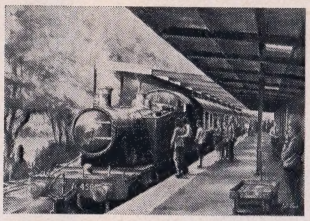

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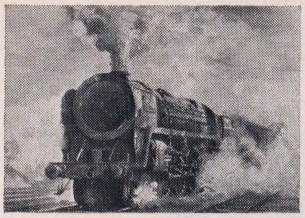

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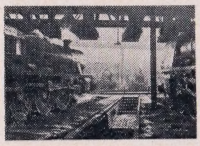

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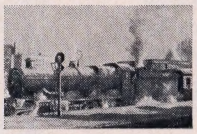

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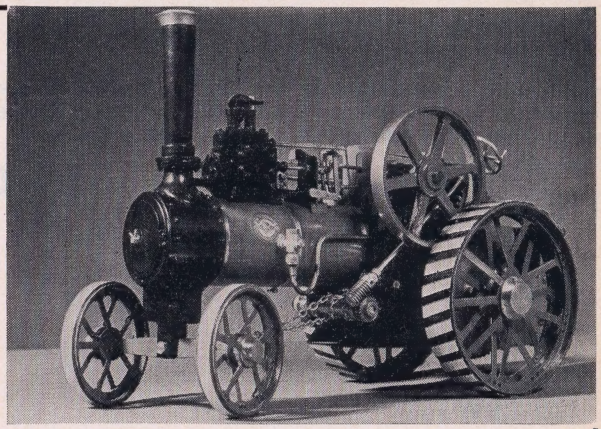

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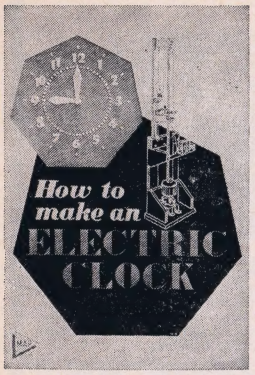

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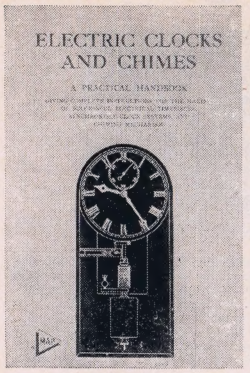

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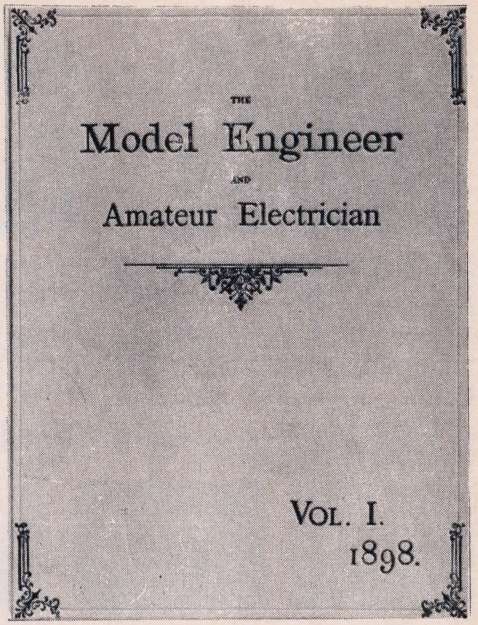

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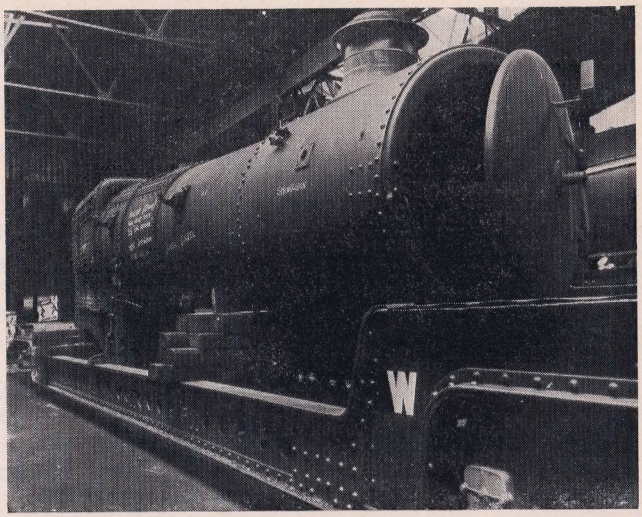
SMOKE RINGS

A Commentary by the Editor



"Castle" class locomotive No. 5051 "Earl Bathurst" being restored at Didcot Engine Shed. The boiler is on a "Crocodile F" wagon.

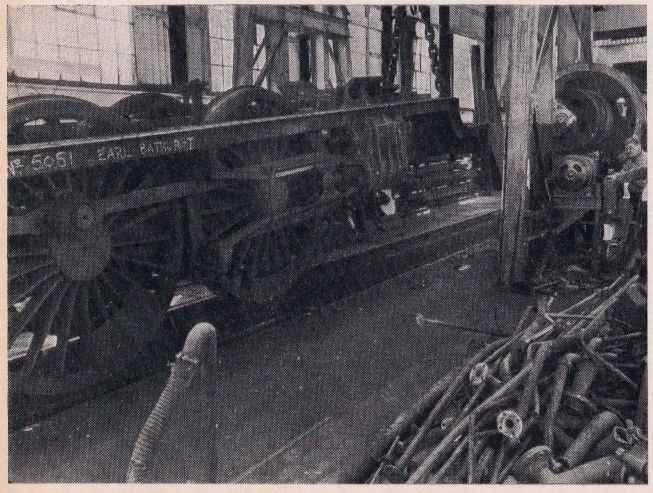
Inventors' Fair

An "inventors' fair" is to be held at Kingsbridge, Devon, from 25 to 30 April next year. The idea is to encourage individuals to show their inventions or ideas in the hope that development and marketing may be less of a problem than it is at present. There will be classes for general mechanical engineering, machine tools, metalwork, electronics, photography and toys, to mention only a few. Full details can be obtained from Tomkyf Ltd., The Old Surgery, 116 Fore Street, Kingsbridge, S. Devon.

Engineering Exhibition

Over 1000 organisations will be represented at MACH 76 — the International Exhibition of Machine Tools, Gauges & Tooling—which is to be held at the National Exhibition Centre, Birmingham, from 22 September to 2 October.

Below: The front end of the frames of "Earl Bathurst" after removal of the bogie and before removal of the driving wheels. In the foreground is some of the pipework.



Anniversary in Northern Ireland

The Association of Model Engineers, Northern Ireland, is celebrating its fifth Anniversary this year with an inaugural meeting on 6 October at which a series of short lectures will be given. These are "A short history of the steam engine", "Model Engineering whys and wherefores", "Miniature locomotive construction", "Scale model ship construction", "An introduction to fine clock making", and "Machine tool construction". The meeting will be held at 7 p.m. at the Ashby Institute, Stranmillis Road, Belfast.

Secretary: W. J. Gilles, 28 Glen Road, Comber, Co. Down, Northern Ireland.

Small "O" Rings

My note on the question of the supply of small "O" rings has brought the comment from Live Steam Services, of 6 Kennet Vale, Brockwell, Chesterfield, that this company are regular stockists of "O" rings as small as $\frac{1}{8}$ in. bore.

Blowpipes for North Sea Gas

Readers who have had trouble with their blowpipes and torches using North Sea Gas may be interested to know that, according to reader L. Spencer of Brighton, a very good torch is manufactured by Delford Combustion Engineering, Ricksmansworth Lane, Chalfont Common, Chalfont St. Peter, Bucks. It is known as the "Carlisle" universal gas/air torch.

A VERTICAL COLUMNAR ENGINE

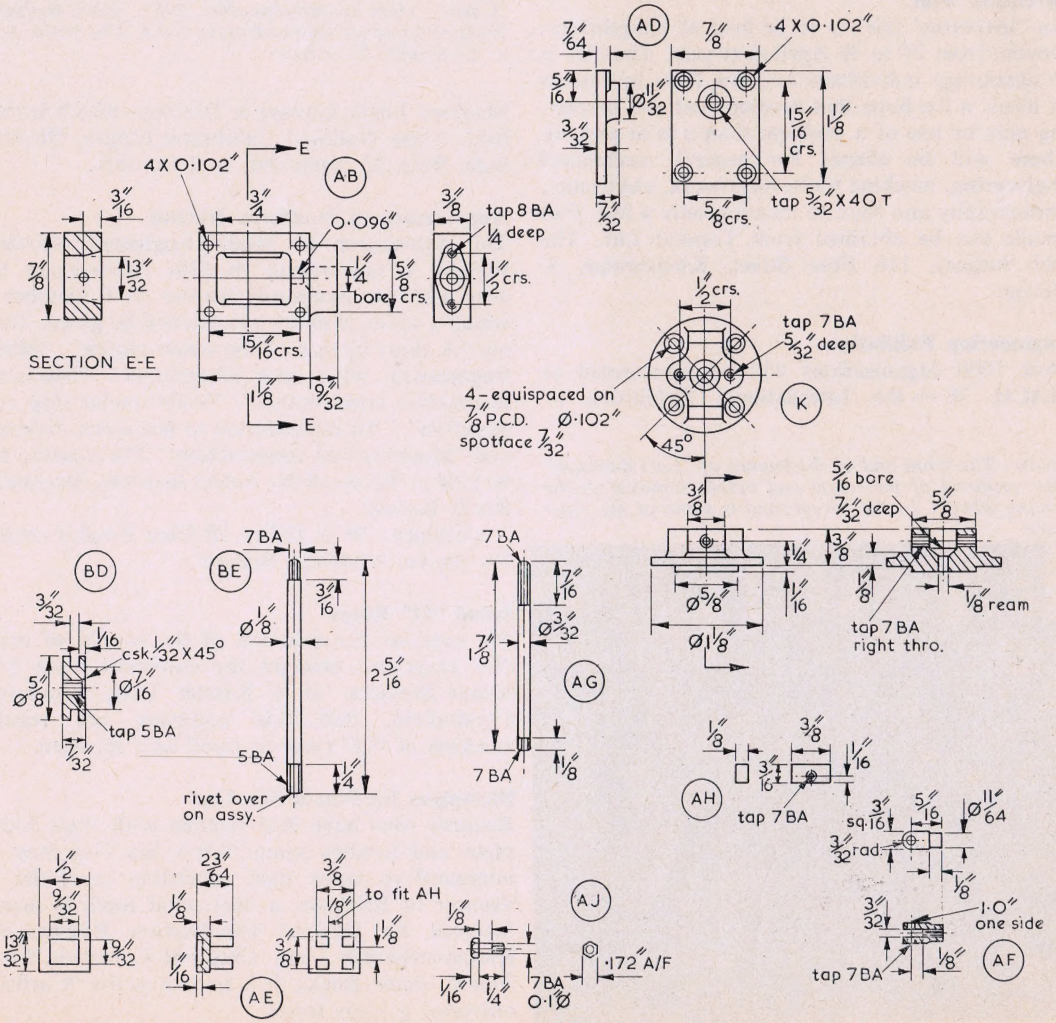
"Tubal Cain" describes how to build a model of the "Williamson" engine

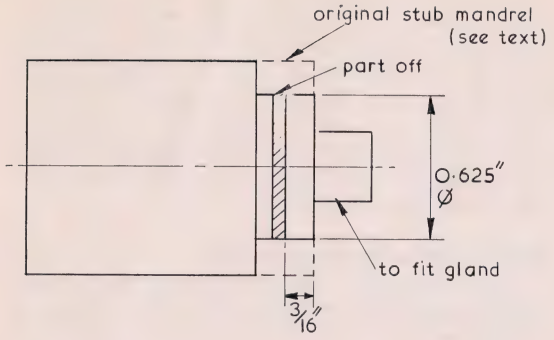
Part IV

From page 850

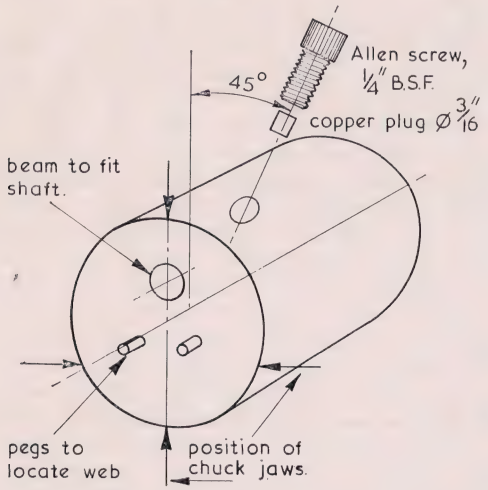
SET UP the rear cover (K) in the 4-jaw, boss outwards, and rough machine the flange O.D. Face as much of this as you can, and the face of the boss. Centre and drill say 15/64 in., then bore to a nice slide fit on the gland. Recentre the bottom of the hole with a small Slocombe and drill and ream $\frac{1}{8}$ in.—take the hole right through the chucking piece. Mark out the two centre-lines whilst in the lathe and, though we will not be using them for machining purposes, two lines at the $\frac{5}{8}$ in. dimension of the flat faces. You can also mark out for the four studholes. These are shown at $\frac{7}{8}$ in. PCD but you will find that these lie on the corners of a square of nearly $\frac{5}{8}$ in. side (0.619 in., to be exact!) and it is easier to do it that way.

Remove from the chuck and make a stub mandrel from a piece of $\frac{3}{4}$ in. or $\frac{7}{8}$ in. material. This is going to serve another purpose later, so let it project between $\frac{3}{4}$ in. and 1 in. from the chuck jaws and make the stub only just long enough to fit the gland. Drill and tap for a 6BA retaining screw if the gland hole isn't a tight fit. (You can always get it off by warming





JIG BUTTON FOR CYLINDER COVER Fig.13



CRANKSHAFT HOLDING FIXTURE. Fig. 15

it). Take light cuts and finish machine the O.D. to 1⅛ in., face, and form the spigot. NOTE, the face dimension of ⅜ in. between the face of the boss and the under face of the flange is more important than the thickness of the flange. Remove from the mandrel.

Now turn the mandrel down to make a jig-button as in Fig. 13 for use when milling the flats. Make the diameter to 0.625 in. by micrometer and part off. This plug, when fitted into the gland hole, will be a gauge to help get the flats correct. Set up the vertical-slide and take more than usual care to get it square —the working face parallel to the axis of the mandrel, which means you can use a DTI to check with. Fit the gauge to the cover and clamp to the vertical-slide making sure that you can get at one of the scribed lines to set it truly vertical. I found the set-up a bit of a fiddly job as there wasn't much room to see, but you must persevere and check carefully. It would be wise to have the clamp vertical.

Look at the drawing and you will see a part section showing a shoulder ¼ in. below the face of the boss. The width of this is not important, but the ¼ in. dimension *must be the same for both faces* —it helps to locate the slide-bar brackets vertically. Proceed as follows. Fit an end mill about ⅜ in. diameter in the 3-jaw—use paper to get it running true. Check that the clamps and bolts on the vertical-slide are tight. Engage the leadscrew handwheel and advance the saddle till the cutter just brushes the ⅝ in. gauge plug. Note the index reading. Next, operate the cross-slide with the cutter clear of the gauge until the cutter just brushes the face of the gland-boss. Note this index reading. Run the saddle clear, and advance the cross-slide 0.250 in. and lock it. Use the leadscrew handwheel to put on cut (I suggest 0.010 in. at a time) and the traverse with the vertical-slide, repeating till you reach the index reading previously noted for the leadscrew handwheel. When you get within a few thou of this, keep an eye on the gauge plug. If this shows a witness that the cutter is touching it, stop there. Your mandrel may expand in use, there may be slack in the leadscrew thrust, or in the half-nut, but the fact that the cutter is touching the plug is all that matters. So, take off the last few cuts a thou or so at a time.

Now without altering the cross-slide turn the workpiece round to offer the other face to the cutter. This time, though, square up the work by using your try square against the face you have just machined, ignoring any centre-lines. Take your usual meticulous care over the job! Then repeat the machining procedure on this face as before. The critical faces will now be within a thou or so of the dimension desired, truly square and parallel. One thing, though. When did you last check the squareness of your vertical-slide? Some of them aren't!

Before removing from the machine set the work with the boss centre at lathe centre height and scribe a line across the faces to mark for the 7BA tapped holes. Remove from the machine and show the faces to your micrometer. If they lie between 0.623 in. and 0.626 in. leave well alone—so long as they are parallel. If not, then make a note and remember to look at it when you come to deal with the upper guide supports and the crosshead slippers. You can now drill for the four studholes, spot through and drill for the gland studs, and drill and tap the two 7BA holes in the faces. These (and the gland studs) must be truly upright; it doesn't matter that the hole will break through into the gland cavity, but clean off the burr. Spotface the nut seatings to 3/32 in. thick, clean up, and remove all burrs.

Clearly all this accuracy will be wasted if the cylinder cover is not properly aligned on the cylinder, so the positioning of the studs in the latter is impor-

tant. Lay the cylinder, portface down, on the lathe bed and lightly clamp the cover to it. Align this with a square against one of the crosshead faces and tighten the clamp. Check that nothing shifted. Upend the assembly and spot through No. 37; mark the cylinder and cover so they will go together right way round, and then drill and tap the four holes. And that is that—except that when you come to make the joint for this top cover you must see that there are no wrinkles or bits loose on it, which might throw the cover over.

Valve and Rod, Parts AE to AJ

The valve comes as a hot pressing, not a casting, and you will find it nearly spot-on to size. Rub the valve face on a fine flat file and then either with a little scraper or fine emery paper bring it dead flat, checking with marking blue. Fit the sides to the valve-chest if you haven't done so already, making sure the sides keep square to the ends. The latter need no more than a polish to get a sharp edge, and if it is then a shade over length, don't worry. I have designed with a very late cutoff so that the engine can run really slowly when on exhibition, and a bit of extra on the valve length will do no harm. You must now prepare the valve-nut, part AH, and fit to the slot in the valve. You will get a little bit of material for this which fits as it is, but I always find it difficult to tap such a small piece dead square. So, chuck a piece of round brass bar, face the end, centre, drill, and tap, guiding the tap itself from the tailstock chuck. Part off a few thou over thickness and then file it to a more or less rectangular shape—the rounded ends don't matter.

Fit this to the slot in the valve; first clean the faces of the slot till it is parallel, then file the parted-off face of the nut till it is a nice slide fit. You will have to deepen the slot a bit, but it is just as easy to file a bit off the nut—the object of this is to ensure that when assembled the valve can lift say ten thou off the port face to let out any water that may be trapped in the cylinder. I suggest you leave this operation till you have made the valve rod, then you can try the valve, nut and rod in the steam chest. For the valve rod, first part off to dead length and then screw each end in turn using your tailstock die-holder. Make the short thread which goes into the forked end a trifle large so that it is a tight fit.

For the fork Part AF, you are supplied with a bit of 3/16 in. square stock. Grip in the 4-jaw and set true, then face the end, turn the little shoulder, drill, and tap—again guiding the tap from the tailstock chuck. Mark out and cross-drill tapping size for the pin hole, then open up halfway through No. 42. Tap from that side, so that the 42 hole acts as a guide. The slot is simply formed with a warding file, but you can use a slitting saw the right width if you are prepared to take a long time over it. Finally, round off the end to look nice. NOTE, at the time of writing it is not clear whether the bolt, part AJ, will come ready made, or a piece of stuff to make it from. The latter operation is a kid's practice job, so I won't describe it, but in either case, check the diameter of the parallel part and if need be drill the fork, and the eccentric rod, to suit the diameter with no slack.

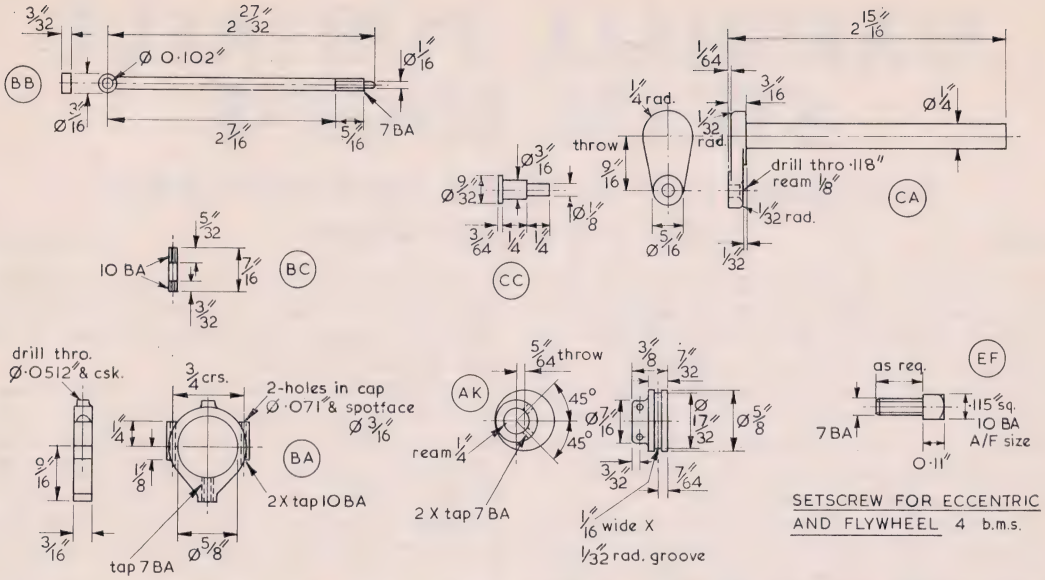
Piston and Rod, Parts BD and BE

Chuck the piston by the chucking piece with sufficient projecting to ensure that you can get a parting tool in. Face, turn the O.D. to say .005 in. oversize, and rough out the groove. Centre and drill No. 38, right through, clearing chippings frequently to ensure that the drill doesn't wander. Tap 5BA guiding the tap from the tailstock chuck. Go in a few threads with the taper tap, follow with the plug and finish say 5 threads, then repeat with the taper for 5 threads and so on. This way there is less risk of the thread going off true. Take a final skim off the face, and finish turn the groove; then part off almost to correct thickness—leave a trifle on for finishing when fitted to the rod. To make the latter, part off to 1/32 in. over the correct length and chuck in the 3-jaw. Check for truth and fit paper if it is more than a thou out. Turn down one end to 7BA—make it .095 in. to allow for the way the metal squeezes up into the die—and screw with the tailstock dieholder. Reverse in the chuck, and screw the other end 10½ threads x 5BA. Degrease, anoint with Loctite, and screw on the piston. Get it hard on, and then lightly rivet the end of the rod. Don't belt it—just a lot of gentle taps till you have a nice overlap of the hole. Trim the O.D. down to a slide fit in the cylinder, and face the end. (This will be the parted-off face) taking off the rivet head too if you like.

Now, if your chuck runs out so much that paper doesn't help, or, worse, if it holds the rod on the slant, make a little blind collet. Chuck a piece of ¼ in. brass or aluminium, about ½ in. long, grip only enough to hold it firm, and face the end. Centre, drill, and ream this very carefully to fit the rod. Put the rod in place, and add a little pressure on the chuck jaws; this should grip the rod firmly enough for the final machining of the piston diameter, and will be true.

Eccentric and Strap, Parts AK and BA

The Eccentric is an iron casting with a chucking piece. Many ways of dealing with eccentrics have been described—use the one you fancy most. For a change I departed from my usual method of calculated packing in the 3-jaw and did it like this. After trimming, hold by the body and true up the chucking piece. Now grip the latter in the 3-jaw and turn the O.D. to correct diameter less say one



thou clearance. Form the grove with a narrow round-nose tool, setting it a little towards the eccentric boss so that it will be central when finally machined all over. Take care to get a really good finish on the eccentric—friction at this point is one of the main losses in a steam engine.

Return to the 4-jaw, again gripping by the chucking piece and set it off centre by the designed throw (5/64 in.). Use a dial indicator to get it right, remembering that the DTI will give an indication of TWICE the offset. If you haven't a DTI use the cross-slide index as a micrometer "touch gauge". Machine the boss, taking light cuts and face this and the side of the eccentric sheave. Centre, drill (stopping when you get to the chucking piece) and bore to size. Take from the chuck, saw off the chucking piece, and then hold by the boss and face the outside. Finally, mark out for and drill for the two 7BA setscrews.

The eccentric strap comes as a single casting, and the first job is to divide it into two, keeping an eye on the drawing so that the cut is in the right place. File or mill the faces smooth and solder together with soft solder. Get a good joint as by the time you have finished there will be precious little "joint" left! Set up in the 4-jaw, so that the joint runs at centre-height when horizontal, and the outside of the casting is true the other way. Face the outer side. Bore the hole till it is a close slide fit on the sheave. Whilst still in the chuck mark out for the height of the "ears" and the vertical centre-line. You can also scribe a line round at 13/32 in. radius to give a guide when filing the profile later.

Take from the chuck, and make a stub mandrel to fit the strap; not a tight fit, or the solder will give way. If it slips, rig up a clamp on one of the chuck jaws to act as a driver. Machine to width and then scribe a vertical centre-line on this side also. Remove from the mandrel, but leave the latter in the chuck. File the ears to the correct height and the boss to which the eccentric rod will be attached—this last to be flat as well as to size. Return to the mandrel, set the vertical centre-line horizontal, and mark out for the two 10BA screw holes. Mark the two halves so that they go back the same way. You have finished with the mandrel now so remove it.

If you have a good drilling machine and vice, then you can simply mark out crossways for the bolts, and then drill and tap; drill clearing size till you reach the join and then follow tapping size, and tap with the top end acting as a guide. If your machine is not so hot then it will pay to set up the vertical-slide with a vice to hold the workpiece, and drill from the lathe chuck. You can drill and tap for the eccentric rod too. Finally, file all round to profile —fit the 10BA screws, or it will come apart—making sure that the overall width is correct or under-size, not over or it will foul things.

Eccentric Rod, Part BB

I think you will find this comes with the eye end ready drilled, as I have used a standard part from another engine. It may even come finished, in which case it may need altering as to length! This may seem an odd procedure, but with wages at their present level it is far cheaper to use an existing part made on automatic machines than to have a chap cutting up odd bits of rod to send to you for you to make it.

To be continued

ERRATUM

Page 743 (6 August). First line. The figure of 5 13/16 in. should read 4 13/16. in.

MARSHALL PORTABLE STEAM ENGINE

A new project by W. J. Hughes, who describes how to build a $1\frac{1}{2}$ in scale version

Part III

From page 809

IN MY INTRODUCTORY ARTICLE to this project I mentioned that the engine in full size would be of 7 nominal horse-power. With the model's bore and stroke of 1 1/16 in. and $1\frac{1}{2}$ in., respectively, scaling up to $8\frac{1}{2}$ in. by 12 in., this normally would apply, and in fact the Marshall traction engine is so delineated. This n.h.p. business was not based on any scientific formula, and neither the stroke nor the working pressure entered into it.

As explained in *A Century of Traction Engines,* one nominal horse-power was deemed to be equal to "10 curricular inches of piston area", and to work this out you squared the bore of the cylinder and divided it by ten. As an example, for a 9 in. bore, $9 \times 9 = 81$, and this divided by 10 gives 8 n.h.p. For a 7 in. bore, $7 \times 7 = 49$, giving 5 n.h.p.

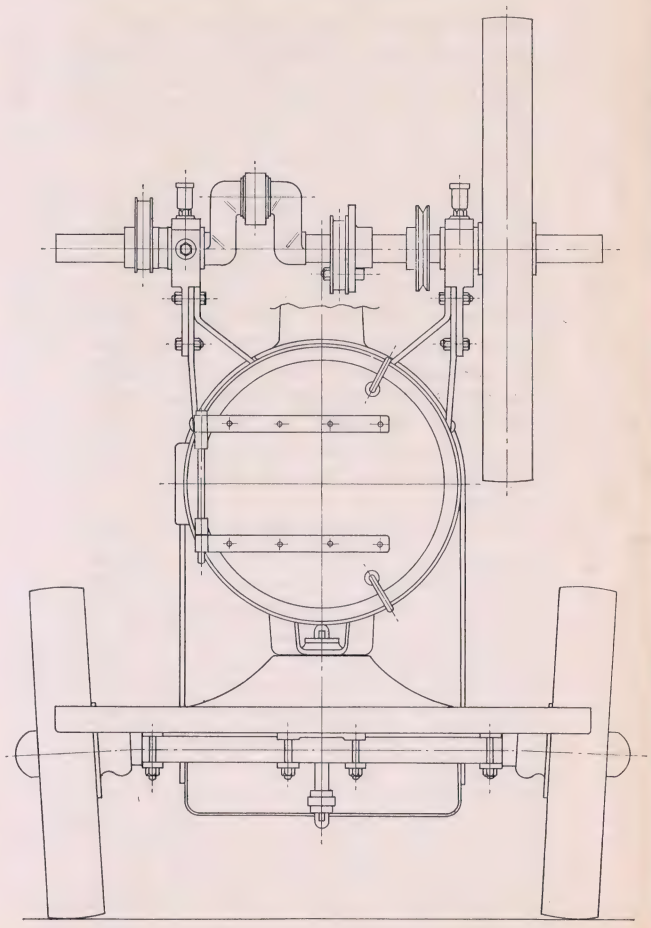
On this score then, an $8\frac{1}{2}$ in. cylinder would give 7 n.h.p. However, when I came to re-check my drawings against the official works general arrangement drawing, I found that the latter bears the legend "6 hp noml. single cylr. porte. Eng.", although the cylinder diameter is $8\frac{1}{2}$ in. So since this is the official description, it is the one I have put on my own drawings, which two or three people have queried on this score.

As a point of interest, by the way, the original official drawing, made in the early 1900s, bears the dimensions in millimetres as well as in Imperial sizes, as mine do. The reason is, of course, that Marshalls (and other British makers) had a very thriving export trade to "metric" countries of portable and other engines.

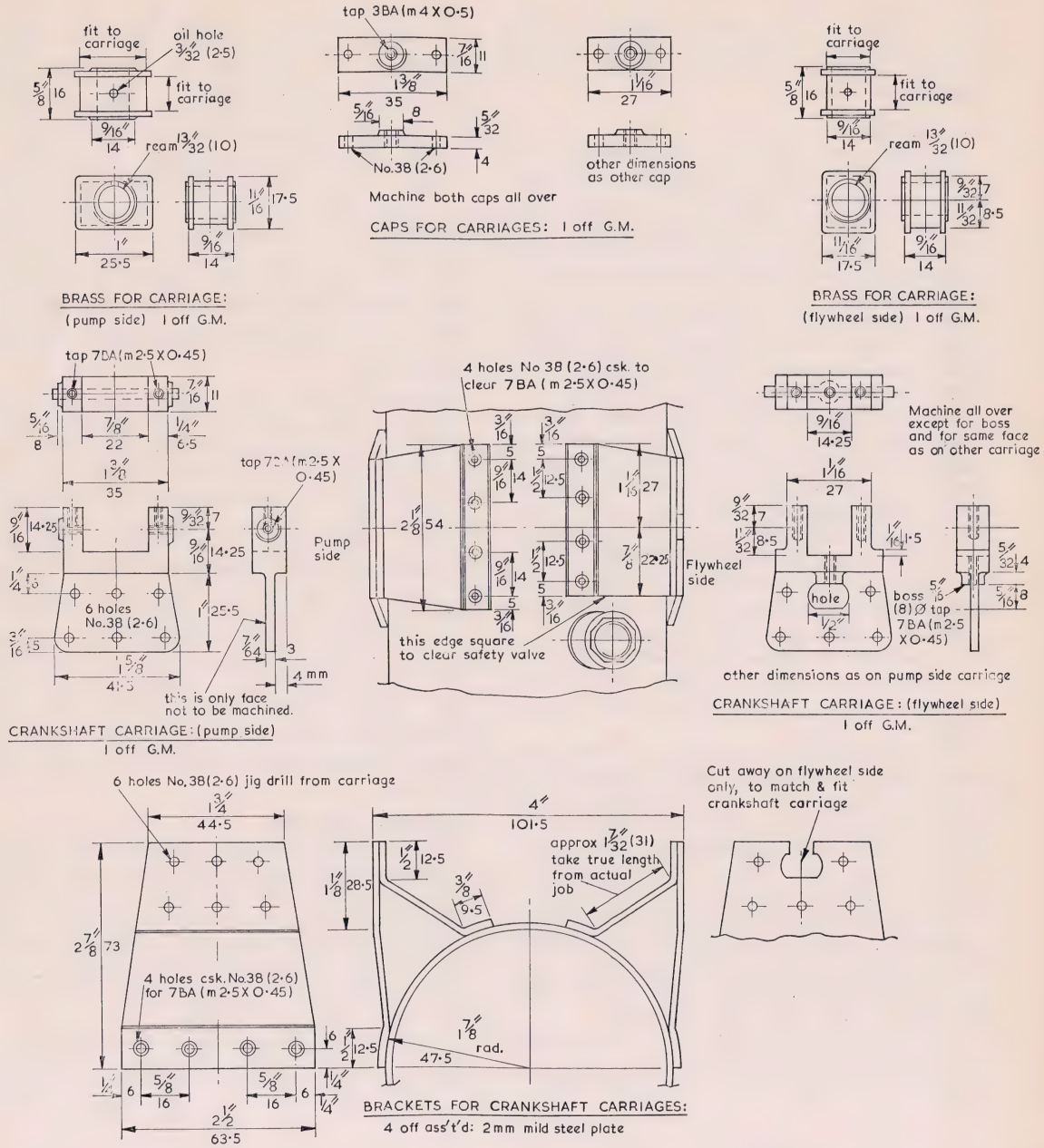
Two other readers have asked if Marshalls made a semi-portable "overtype" engine based on our example, and for anyone else interested the answer is "yes". It is illustrated in one of my catalogues, and in general is identical to the wheeled version. In fact, it even has the perch bracket (for the front axle turntable) just behind the smokebox underneath, and has the angles for the hind axle secured to the sides of the firebox.

So anyone who may wish to make the model an overtype can go ahead in the knowledge that he will not have to scrap anything later. The chief differences are firstly that the firebox will be supported on a tray-shaped casting which also forms the ashpan, and secondly that the smokebox is supported on a box casting which also forms the water supply tank. I hope to produce drawings of these, and no doubt our friends at Reeves will supply the castings, when indeed, if there is sufficient demand, of course.

But to get back on the job! I am assuming that the boiler is now part-built sufficiently to start fitting bits and pieces on a trial basis. But first of all, in order to prevent damage to the outer firebox wrapper which is open and unsupported, it will be advisable to refit the boiler front in place. It can be secured using the temporary nuts and screws



GENERAL ARRANGEMENT: FRONT VIEW Fig. 1.


fit to carriage
oil hole 3/32 (2·5)
fit to carriage
ream 13/32 (10)
BRASS FOR CARRIAGE:
(pump side) 1 off G.M.
tap 3BA (m 4 X 0·5)
No.38 (2·6)
other dimensions as other cap
Machine both caps all over
CAPS FOR CARRIAGES: 1 off G.M.
fit to carriage
fit to carriage
ream 13/32 (10)
BRASS FOR CARRIAGE:
(flywheel side) 1 off G.M.
tap 7BA (m 2·5 X 0·45)
6 holes No.38 (2·6)
Pump side
this is only face not to be machined.
CRANKSHAFT CARRIAGE: (pump side)
1 off G.M.
4 holes No 38 (2·6) csk. to clear 7BA (m 2·5 X 0·45)
this edge square to clear safety valve
Flywheel side
Machine all over except for boss and for same face as on other carriage
hole
boss (8) Ø tap 7BA (m 2·5 X 0·45)
other dimensions as on pump side carriage
CRANKSHAFT CARRIAGE: (flywheel side)
1 off G.M.
6 holes No. 38 (2·6) jig drill from carriage
4 holes csk. No. 38 (2·6) for 7BA (m 2·5 X 0·45)
approx 1 7/32 (31) take true length from actual job
rad.
BRACKETS FOR CRANKSHAFT CARRIAGES:
4 off ass't'd: 2mm mild steel plate
Cut away on flywheel side only, to match & fit crankshaft carriage

DETAILS OF CRANKSHAFT CARRIAGES & BRACKETS Fig. 2

as previously; at this stage it will carry no bushes or other fittings.

In the full-sized engine, the crankshaft fits into split bushes or brasses which slot into castings—the crankshaft carriages—which in turn are bolted to sheet steel brackets riveted to the boiler shell. On the pump side the bush has to take the back and forth thrust of the connecting rod, so it has more metal in that direction and is split vertically, with horizontal screws for adjustment. On the flywheel side the brass has to take the weight of the wheel vertically, so has more metal underneath, as well as the adjusting screw. It is split horizontally.

On the model I do not consider it necessary to split the bushes. Wear will be very little, and if eventually it does take place it is probably quicker and easier to bore out the brass and sweat in a new shell bush than to try to refit the worn hole

to the shaft. So in our case the adjusting screws will be dummies—though naturally any builder wishing to use split bushes will follow his own inclinations.

The Brackets

As shown on Sheet 3 of the drawings, the brackets on the model are secured by countersunk screws, which will be hidden by the lagging. They are cut to shape from 2 mm. bright mild steel plate or strip, and it will be advisable to leave a small surplus on the outer and top edges to allow for final lining up.

The outer brackets are identical except that there is the cut-away on the top edge on the flywheel side, but again leave this until the carriage is being fitted. And don't drill any holes at this stage.

The lower edge of these brackets can be hammered over a piece of steam barrel, or other suitable mandrel, to fit the curve of the boiler barrel. Then grip the bracket in the vice jaws with the curved edge uppermost, place the edge of a piece of hardwood lengthwise against it, and hammer the wood to bend the curved edge outwards (Fig. 3A). Take care not to overdo it, as b.m.s. will not stand much bending to-and-fro. Now use the same technique to make the second bend higher up—a very small one this time, be it noted. Check the end views of the brackets carefully with their end elevation. Drill the four No. 38 (2.6 mm.) countersunk holes in each.

Place the brackets in position on the boiler barrel and use toolmakers' clamps to secure them for the time being. Check the centre lines for lining up with each other and with those on the barrel: check the 4 in. (101.5) measurement across the top. When all is in order drill and tap for one of the outside screws, through the wall of the barrel and into the square section reinforcing bar, but try not to penetrate into the water space inside. Insert a screw, and check again for lining up. If all is well, drill and tap the hole near the other outside edge, and insert a second screw. Check again.

It will be seen in the plan of the brackets that the inner ones are not identical, since that on the flywheel side is squared off to clear the forward safety valve. After cutting and filing these to shape, it will be necessary to anneal them since almost certainly bright mild steel would not stand the sharp bending needed, without cracking. For this, heat the brackets to medium red and allow them to cool slowly. Clean them up with emery cloth.

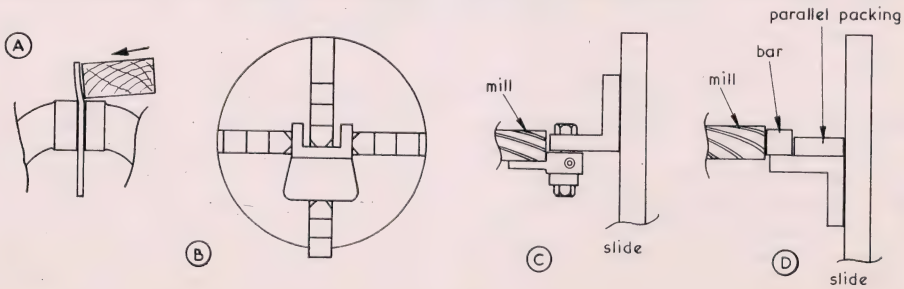
Before making the actual bends it will be helpful to make a template from cardboard to check that the measurement given as 1 7/32 in. (31) actually is correct. The important points are that the distance over the outer brackets should be 4 in. (101.5), the top edges of the inner brackets should come exactly level with the outer ones, and the inside $\frac{3}{8}$ in. (9.5) flanges of the inner brackets should line up with the reinforcing strips inside the boiler barrel.

Bend the brackets to shape just as the outer ones were done, trying them in position frequently so as to avoid over bending. Drill and countersink the fixing holes in the $\frac{3}{8}$ in. (9.5) flanges. Finally clamp them in turn to the outer bracket and pump barrel, and drill and tap for the fixing screws. Remember that for *final* assembly the screws should be bronze or gunmetal, and not ordinary brass, which in contact with a boiler can be eroded by electrolytic action. Clamp the tops of the brackets, and check them for lining up with each other, with the top of the boiler barrel as viewed from the side and the front, and with the sides of the barrel from above. Remove them if necessary, trim off any surplus with a smooth file, and drawfile the edges before replacing them. Do not drill the upper bolt holes yet.

Crankshaft Carriages

The crankshaft carriages are gunmetal castings, and despite their different shapes the basic machining is similar for both. It can be done by end milling in the lathe, with the work piece on the vertical-slide, or of course on a milling machine itself. We will deal with the lathe method since of necessity this will be the most popular, but it can be adapted easily to the miller.

Clean up the castings as usual by smooth filing, and now we need a true reference surface. This can be the inner face of the upper "jaw" of the



MARSHALL PORTABLE ENGINE

FIG. 3

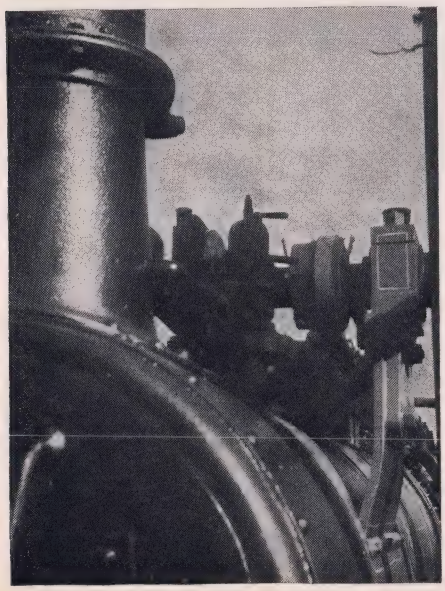
casting. Grip the latter in the four-jaw chuck as sketched (Fig. 3B), and take a skim off the face. Repeat this on the other side. Mount a small angle plate square across the surface of the vertical-slide (Fig. 3C), and clamp the casting to it, with the true face uppermost. The face of the bolting flange can now be milled, to finish at 4 mm. below the trued surface. At the same setting the bottom edge of the carriage can be milled off at 1 in. (25.5) outside the "step", and if there is any surplus on what will be the outside of the flange this too can be removed. But don't clean right up into the corner, which is rounded off and not square.

Again repeat all this on the second carriage. Now each in turn can be clamped by its flange to the angle-plate, and the opening in the jaw milled out true, with the thickness of the jaws milled to 7/16 in. by micrometer. On the carriage for the flywheel side, the central hole for the adjusting screw may be drilled and tapped through the boss at this setting. On the pump side casting, the screw holes can be drilled and tapped with it held in the four-jaw chuck, the small boss on each end being skimmed up at the same time.

The two screws on this side are not drawn separately, being ordinary hexagon headed ones fitted with a locknut. The one on the flywheel side is a short length of studding with one end squared to take a tiny spanner, and, ideally, case hardened. It cannot be inserted into the boss from below, but has to be screwed in from above before putting the brass in position. A locknut is fitted to secure it.

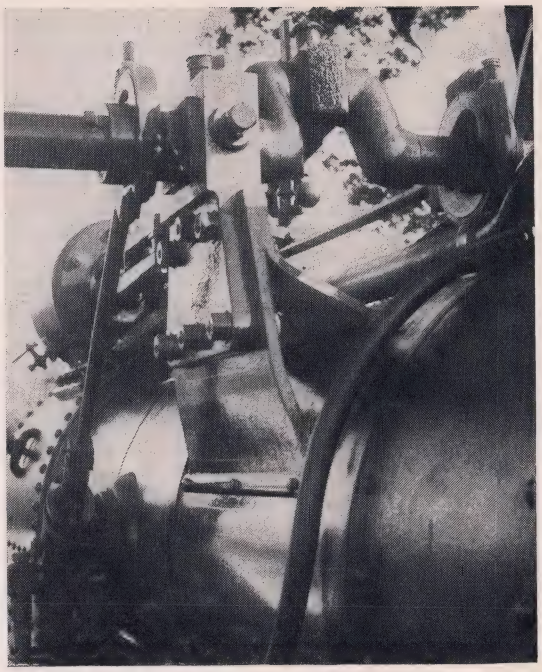
Lastly, drill the bolt holes in the flanges, but not yet in the brackets.

The brasses may be machined from bronze or gunmetal bar of $\frac{3}{4}$ in. (19) square section, and again



Top right: Fig. 4.

Left: Fig. 5.



the work can be done on the lathe or partly on the milling machine. A 2 in. (50) length will be needed. Grip it in the four-jaw chuck and face up one side. Clamp the bar with this face down on an angle plate secured to the vertical-slide, and face up a second side square with the first. Turn the bar back through 90 deg. so that a true face is next to the vertical-slide, and place some parallel packing between the two. Press the bar up to the packing—it must be thick enough for the bar to project over the edge (Fig. 3D) of the angle plate and clamp it down again. Mill the third face off, to leave the bar $\frac{5}{8}$ in. (16) thick.

The fourth face now needs to be similarly machined off, to leave the bar 11/16 in. (17.5) thick. Change the end mill for one of 7/16 in. (11) width, and mill a groove centrally down this edge of the workpiece, 1/16 in. or 1 mm. (full) deep. Turn the bar end-for-end, and similarly groove the opposite face.

Take a skim off the ends, to square them up, and groove these. Then saw the bar in two, face up the two remaining ends to length, and groove these. The brasses may need easing slightly to fit them into their respective jaws, but they do need to finish a good fit with no shake.

Set out the centres (noting that on the flywheel side it is not central!), and in turn centre drill, drill, and bore the holes a few thousandths undersize. Ream at 13/32 in. (10), but if a reamer is not available, finish the holes to size by careful boring, working to a plug-gauge. The spigots on the outsides of the brasses may be turned on a

stub mandrel. They are 1/32 in. (0.75) deep by 9/16 in. (14) diameter. Lastly, slightly round the corners of the brasses, and drill the oil holes.

The caps are simple turning jobs, and have chucking spigots to help in the machining. File up or mill the outer edges to size: in the width they should be a good fit in the grooves of the brasses. After drilling the No. 38 (2.6) holes at $\frac{1}{8}$ in. from the ends, use these to spot through, drill, and tap for the fixing studs. Fit up the brasses and caps in the carriages, and clamp these temporarily to their brackets, with a 13/32 in. (10) diameter rod through the holes to help in lining up. It should be rotatable, horizontal when viewed from the front, and square across the boiler barrel when viewed from above. Drill the bolt holes through the brackets and fix the carriages with temporary screws.

The brass lubricators are simple to make and need no describing here. It is suggested that a third one be made at the same time for eventual fitment to the big end of the connecting rod.

My photographs show the brackets and carriages quite well, though all the details are not exactly the same. On Fig. 4 note also the pump, with its eccentric keyed to the crankshaft, the nicely forged and rounded dip of the crank itself, and the slotted valve eccentric for varying the cut-off and the direction of rotation. The pipe on top of the boiler is the exhaust, and that curving down in the foreground is the bleed from the exhaust for feedwater heating.

Besides the carriage and bracket on the flywheel side, Fig. 5 shows the pulley and flat belt for the governor drive: my drawing shows a vee-pulley which Marshalls also used alternatively. In front of this is the forward safety valve with its pipe bleeding steam from the blower in the chimney base. At the front we see also one of the dogs on the smokebox door.

AUSTRALIAN LOCOMOTIVE TRIALS

by B. Glover

THE STORY of A.M.L.T. goes back to 1972 after discussions and comments by a few Club members of the I.M.L.E.C. results as appearing in the *M.E.* It was thought that a similar contest here on a national basis would create added interest and especially at the Annual Convention held during Easter each year.

All Clubs were duly sent an outline of the proposal and it was placed on the Agenda of the Convention Meeting where the outcome was that the Illawarra Live Steamers carry out Trials and report again the next Easter.

This we then commenced to do and as no drawings of Birminghams' Dynamometer Car were available, it was decided to use a simpler device for Trials so a spring balance and measuring device was incorporated into one of the existing Club wagons. A N.S.W. Trial was duly held on 21 October 1973 using this device, where readings on the gauge were taken at selected points to give an average draw bar pull.

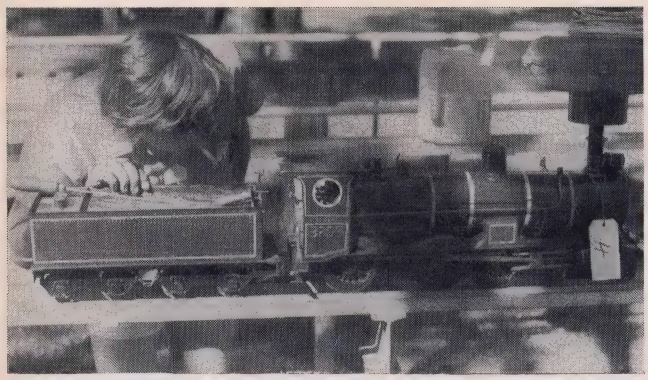
A ten-page Report and Recommendation was prepared and presented to the 1974 Convention where the idea was accepted in principle but not the idea of running a Competition in conjunction with the Convention. Undeterred and having the support of the majority of N.S.W. Clubs we went ahead and deciphered the articles on the Birmingham Dynamometer Car and commenced to build one of a similar type. The integrator unit is the same but modifications to the draw gear have been made and the 2-1 draw gear dispensed with. The speedo and duplicate gear for the driver have also been deleted and the spring used to date is rated at 60 lb. max. Hydraulic brakes are fitted and the Car can be used on ground level tracks also. This project was finally completed in January 1976 and of course has been subjected to extensive trials and check calibrations in readiness for the 1st Australian Miniature Locomotive Trials.

It was decided by the Committee that the Trials be held on our original or "Inside Track" which is reasonably level (unlike our Main Track or "Outside Track" which has grades of 1 in 50 and 1 in 40). This construction is 1 in. x $\frac{3}{8}$ bars welded to steel spacers and placed on wooden sleepers. This is supported on concrete piers and beams and is 458 ft. in length with 60 ft. radius curves, roughly oval shaped with a down grade of 1 in 165 for approximately 165 ft. and up grade of 1 in 150 for approximately 150 ft. The location of the Club Grounds is approximately 50 miles south of Sydney beside the Princes' Highway.

So finally the great day dawned with fine warm weather and 16 locos nominated; of these, 8 were modelled on Australian prototypes, 7 being N.S.W. and one Victorian Railways. One alteration to the rules as per I.M.L.E.C. which has been made here, related to the fuel used by competitors. Each person is allowed to use the fuel of his choice and to which his engine is tuned. Fuels vary greatly here and range from about 11,000 BTUs to 13,900 BTUs, and require a wide range of grate spacings and blast nozzle settings to get the best performance. The Coal Board's official value of the various fuels was used and a correction factor derived for each one after determination of a standard fuel, usually the highest value being used.

Run No. 1

This was timed for 8.30 a.m. and was the I.L.S. $3\frac{1}{2}$ gauge entry, a 2-6-0 "Princess Marina" design "Lady Irene" belonging to Cliff McAllister. Cliff is a former member of the Crosby Model Club, and the engine is now 17 years old and a regular runner at the Club. Cliff was ready early so the start was made 5 minutes before the advertised time and he got away smoothly on the rusty rails and was soon lapping at a steady rate. The speed was somewhat slower than Cliff's usual flying style. The odd burst of steam from the pop valves showed that things were well in hand. but after approximately 20 minutes a few very slow laps seemed to indicate trouble. The last few minutes saw the speed back up to normal again and overall it was a good steady run.



Phil. Gibbons steams up.

Run No. 2

This was also an I.L.S. entrant, namely the Club locomotive "Bitza 2". This was driven by Ivo Bunker and is a freelance "American 0-6-0 Switcher". The boiler has a syphon fitted and is fed by axle pump and two injectors. Ivo took a load of 1543 lb. and got away nicely and took the 1-150 without trouble on the first lap and commenced to lap at a steady rate. After approximately 12 minutes he came to a halt through low water and of course trouble with injectors on the run. He was soon away but was forced to stop again shortly after to recover more water. He apparently fixed the trouble because the last 8 minutes were finished without problems.

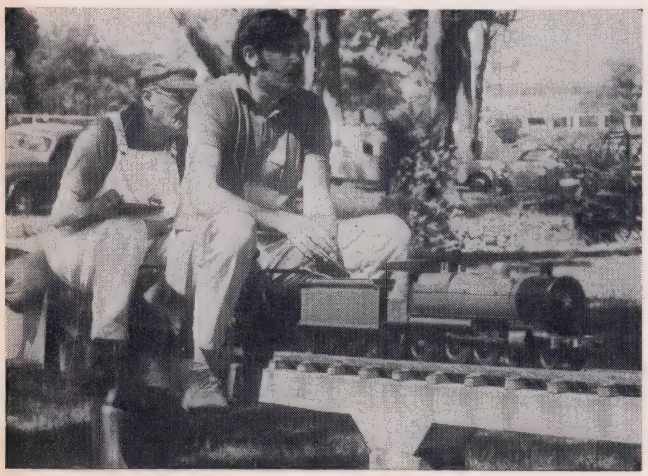
Run No. 3

Dave Merrifield of South Coast Model Engineering Society was next away with a 3½ gauge N.S.W.G.R. C36 4-6-0. Dave's load was 652 lb., and although he got away smoothly he came to a halt at the start of the 1-150 with low steam pressure after travelling approximately 100 ft. Dave had tried to be sparing with his fire in order to conserve fuel and paid the penalty. After a 2-minute delay he got going again and finished the run without further incident with an average speed of 8.166 m.p.h. (Note: This engine is owned by Noel Bruce, also of S.C.M.E.S.)

Run No. 4

Another S.C.M.E.S. member was the next starter.

Col. Wear driving his 3½ in. gauge "C35".



This was Phil Gibbons with his 3½ gauge N.S.W.G.R. C32 Class, and the load was 633 lb. This engine has just recently been completed and Phil got the load rolling smoothly and went on to complete his run without problems.

Run No. 5

This turned out to be the best run by a 3½ gauge engine and gave the owner the I.L.S. Challenge Shield for the Best Performance by a 3½ Gauge Engine. The engine was a N.S.W.G.R. C35 Class owned by the driver, Col. Wear of Sydney Society of Model Engineers and his load was 741 lb. Col. got away with a minimum of slip and was soon lapping at a steady rate. After approximately 12 laps water was seen coming from between engine and tender where a pump hose had come adrift. A short stop followed to carry out repairs and after another 2 laps a stop was made on account of low steam pressure. A quick recovery was made, however, but 3 laps later the hose problem occurred again resulting in another stop because of low water. Once again Col. got under way and finished without further incident. Notwithstanding the three stops which had to be made, Col. managed to get the most amount of work done for the least amount of fuel and so finished best 3½ gauge engine and 4th overall.

Run No. 6

John Griffith of Western Districts Live Steamers was the next runner with his nicely finished 3½ gauge Victorian Railways "R" Class 4-6-4. The prototype, which first appeared in 1952, and built by North British Loco. Company, is a very impressive engine, and no less so was John's effort in its black and red colour scheme. As was expected this engine performed as well as it looks, and apart from some slipping at the start, which John quickly brought under control, he carried out a trouble-free run with his load of 730 lb. John's run was the next best for a 3½ gauge engine but I feel he would have done better with a heavier load.

Run No. 7

Once again a 3½ gauge engine and this time a freelance 2-6-2 owned by Eric Hayes of Hornsby & District Model Engineering Society. Eric got away O.K. but soon came to a halt at the start of the bank. Regaining pressure he attempted to get away again but failed and unfortunately it was discovered that a superheater tube had blown.

Run No. 8

Once again this was by a 3½ gauge engine and this time a freelance 4-6-4 built to American loading gauge. This engine would be, in the opinion of the writer, one of the best three 3½ gauge engines in Australia, and was being driven by its popular builder and owner, Cec Gunning of Sydney Live Steam Locomotive Society. Cec elected to take 1500 lb., a load which he has handled on this track before, but I think on account of the previous failure, Cec hurried his preparation a bit and started out before he was quite ready. After getting going with the big load he came to a quick halt at the bottom of the bank with low steam pressure. After recovery and further attempts to get away which resulted in a number of stops and starts to almost the top of the bank Cec decided to lighten the load by 160 lb. This made sufficient difference to enable him to get away and we soon saw the type of performance that this engine is capable of. This was to no avail, however, as too much time was lost initially to get out a good work figure. I was also

informed that this was the first run by this engine since Easter 1975, due to the rebuilding of the S.L.S.L.S. track.

Run No. 9

This run was by a brand new engine, a 5 in. gauge 0-6-0 tank. By new, I mean just that, as it is still uncompleted and only reached the running stage two days prior to the Trials. The owner/driver, Arthur Mears of the Sydney Society of Model Engineers, is a professional model engineer and supplier of model engineer requisites. As to be expected, this engine is well finished and runs well. Arthur's load was 1649 lb., and he got away smoothly and quickly settled down to a steady run. A short stop for low steam pressure took place on the 25th lap, but his figures overall were good enough to take 3rd place.

Run No. 10

This was also a 5 in. gauge engine, a N.S.W.G.R. D50 Class 2-8-0 owned by Phil Gibbons of S.C.M.E.S. and being driven by Noel Bruce of the same Society. A load of 1416 lb. was nominated by the driver and he completed a trouble-free run rolling along steadily in true "Standard Goods" style.

Run No. 11

Another 5 in. gauge 2-8-0 was next in line, this time a freelance American type by Reg. Wood of S.L.S.L.S. and driven by his son Reg. Wood Jnr. This is a large engine and a load of 1725 lb. was hooked on behind the tender. Reg. Jnr. lifted the load away O.K. but soon came to a halt on the bank through low steam pressure. Reg. had not prepared his fire properly and paid the penalty. The driver struggled to get steam and get away inside the 5-minute period allowed before a run must be terminated. The first 10 minutes or so saw a determined battle by the driver to get going and after numerous stops he succeeded, but of course too late to be of any use.

Run No. 12

This was classed as a "private entry" and was a 5 in. gauge N.S.W.G.R. 4-6-0 C32 class being driven by John Mann of Sydney. This engine had run 1st and 2nd in a Trial held two years ago and this run was awaited with interest. John's load was about 1500 lb. and by this time the track was becoming a bit greasy so the cleaver and sand made its appearance. The start was good but it looked touch and go near the top of the bank as to whether it would stall or not, but over the top it went and of course was right from there on. After about 10 minutes or so anxious looks appeared on John's face and he was doing a lot of fiddling with injectors. Shortly after he stopped and hurriedly dropped the fire, both injectors failed and the run was abandoned.

Run No. 13

The nominated starter for this run was unable to attend.

Run No. 14

Back to 3½ gauge again, this time Maurie Haynes of S.L.S.L.S. with his fine N.S.W.G.R. 4-6-2 C38 (Non Streamlined). Maurie's load was 990 lb. and he was smartly away and putting up his usual snappy performance. This was the style of things for approximately 20 minutes when a slowing down was detected, followed by a stop on the 28th lap. Maurie had misjudged it a bit getting close to the finish and 3812 had run short of breath. By the time a recovery had been made he was only able to get in another two laps.

Arthur Mears gets his 5 in. gauge 0-6-0T ready.

Run No. 15

This was another N.S.W.G.R. type engine, namely 5 in. gauge D59 Class 2-8-2. This engine is a very impressive type and is basically the Baldwin "Light Mikado" originally purchased by N.S.W. Railways as oil burners. The builder, Ray Lee of S.L.S.L.S., has fitted this out as an "oily" also, using a burner of the type described in *Live Steam Magazine*, and he currently has two coal-fired versions of this engine almost completed. Ray backed onto a load of 1942 lb. and on freshly sanded rails lifted this away in terrific style and charged up the bank as if it wasn't there. This set the style for the rest of the run and Ray went on to take the honours for the day.

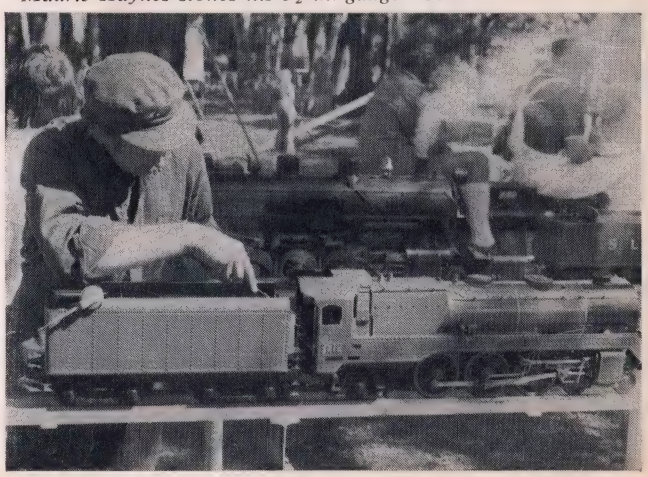
Run No. 16

This was the 5 in. gauge 2-8-0 of Phil Gibbons making its second appearance, this time with the owner at the controls. Phil took a load of 2101 lb., the heaviest for the day, and as with the first occasion this engine gave another trouble-free run but this time showing an improvement sufficient to give Phil 2nd place for the day.

Run No. 17

The final run of the day was made by Alex Russell of W.D.L.S. and was his 5 in. gauge 0-4-0 Rail Motor.

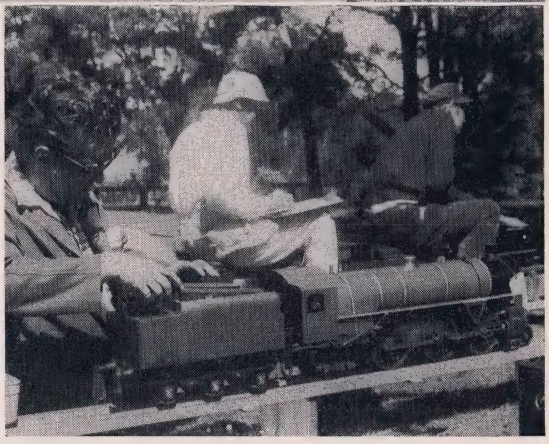
Maurie Haynes stokes his 3½ in. gauge "C38".



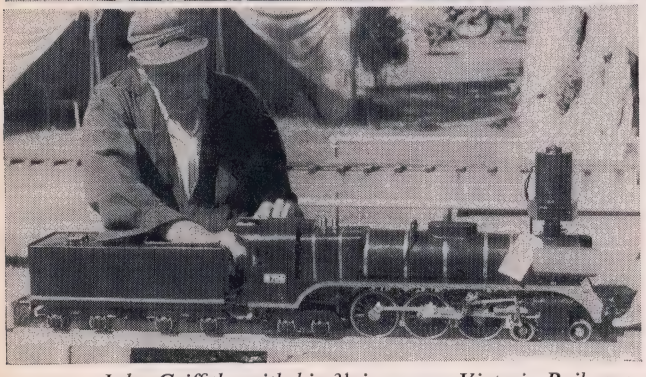
The score board.

Below: Reg. Wood and his son prepare their 5 in. gauge freelance 2-8-0.

No.	NAME	No. of WHEEL ARRAN	LOAD (lbs)	TIME (mins)	DISTANCE (ft)	WORK DONE (ft lbs)	AV. SPEED (m.p.h.)	AV. D/B PULL (lbs)	AV. D/B H.P.	CONTACT TIME (secs)	CALC. VALUE (lbs/in)	CALC. HORSE POWER (in lbs)	%	PLACE
1	C. McAlister	5	2-6-0	6'28	5-083	45840	102600	6·398	7·578	0·129	2·125	12155	38·0%	0·51	
2	T. Bunker	5	0-6-0	15·43	20·02	13550	183900	8·649	13·572	0·278	2·675	13800	30·75	0·5%	
3	D. Arnold	5	4-6-0	6·52	20·15	14480	102600	5·166	7·086	0·154	2·313	13017	51·21	0·5%	
4	F.G. Ibbens	5	4-6-0	6·33	25·12	15400	90600	7·138	9·87	0·112	2·75	13017	58·815	0·525	
5	C. Wear	5	4-6-0	7·41	24·85	10350	111600	4·733	10·763	0·236	1·625	11632	20·383	0·275	(1)
6	J. Gaffer	5	4-6-0	7·30	25·58	10810	96000	4·801	8·88	0·114	2·07	11130	34·638	0·53	
7	E. Hayes	5			N/A	RUN									
8	C. Gunning	5	4-6-0	13·41	15·625	6690	27300	3·87	11·554	0·119	2·875	12600	62·238	0·26	
9	A. Mears	5	0-6-0	18·9	25·012	14960	132000	6·79	10·84	0·178	2·09	11130	24·336	0·525	3
10	N. Bruce	5	2-8-0	15·16	25·2	16280	172700	7·24	11·84	0·230	2·60	13017	24·81	0·25	
11	R. Wood Jr.	5	2-8-0	17·25	25·12	5690	43000	2·03	14·26	0·115	5·75	12600	109·426	0·169	
12	J. Main	5	4-6-0	RE	7·26										
13	T. Lewis	5		W/H	NDRAWN										
14	M. Haynes	5	4-6-2	9·0	25·11	14640	140000	6·38	9·695	0·165	2·737	11130	31·302	0·578	
15	R. Lee	5	2-8-2	17·42	25·32	18610	325300	8·37	20·167	2·450	2·719	18856	19·599	0·941	1
16	A. Russell	5													
17	P. Gibbons	5	2-8-0	21·01	25·45	16730	256130	7·47	15·31	0·300	3·078	13017	22·367	0·525	2



E. Hayes prepares his 3½ in. gauge 2-6-2.



John Griffiths with his 3½ in. gauge Victoria Railways "R" class engine.

Alex was to have run earlier but when getting up steam the whistle valve stuck open and after carrying out necessary repairs was able to finally make his run. His load was 700 lb., and he got away with a slippery start and a struggle up the bank, but once over the top he was away. A high water level was evident by the priming but Alex charged on until about 12 minutes into the run, and a stop was made at the station where a seized wheel was found on the Dynamometer Car and this of course finished the running for the day.

The remaining chore of course was the posting of the final batch of calculations and the presentation of trophies to the winners.

The I.L.S. President, Barry Glover, thanked the competitors and visitors for the keen interest in the day's proceedings, the sponsors for their donation of trophies and all others who had worked to make the first A.M.L.T. a great social success even if the performance figures were on the low side. He then introduced the Club Patron, Mr. Tom Gawn, who presented the prizes to Ray Lee, S.L.S.L.S.; Phil Gibbons, S.C.M.E.S.; Arthur Mears, S.S.M.E.E.; and the best 3½ gauge to Col. Wear, S.S.M.E.E.

ROUND BED LATHES

SIR,—I was interested in Mr. Trotman's letter and to hear about his round bed Drummond No. 2256.

I have a similar machine which I have used for years and is in excellent order and has not been rebuilt. I purchased it secondhand and its number is 1154 so it must be a lot older than Mr. Trotman's.

There is a nostalgia about these Drummond lathes and they are really becoming museum pieces and I feel it would be of interest to have a "round bed register". If anyone is interested I should be pleased to hear from them and should they have a 4 in. Drummond round bed lathe the number of the machine or any information about it, I would be happy to start a register.

Reading. Alan Roscoe-Hudson

RUBBER TYRES FOR MODEL ROAD VEHICLES

by E. W. Sheppard

WHEN ONE TAKES on a new type of model there are usually some new problems to overcome, and such was the case when about three years ago I started my first steam model, a 2 in. scale Fowler showman's engine. One problem which I thought about over some months whilst getting on with other parts, was the tyres. My casting supplier suggested "V" belts put on inside out, with six on each hind wheel and three on the front wheels. Having seen a model thus equipped I promptly decided "not for me"; something more to prototype and better looking must be provided.

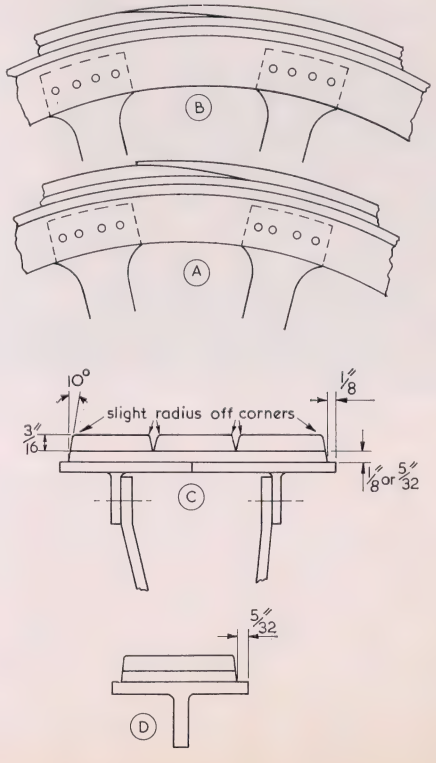
The previous six years or so have been spent building 1 in. scale lifeboats which I use to raise funds for the R.N.L.I., and I found the ideal material in the continuous fender round these boats. It was a left-over from my old shoe business known as "toppiecing" and is a very hard rubber (?) sheet from 3/16 to $\frac{1}{4}$ in. thick. I thought it would make good tyres for my showman's engine, and it has proved most satisfactory. The material is easily obtained, and the process is easy even if a bit tough on one's arm and fingers. The results are near-perfect scale tyres to suit any scale up to 3 in.

There are several brands of this material which can be obtained from either a friendly shoe repairer or a shoe repairer's sundriesman. One make is Fussell's "Rubrox", another is Phillips' toppiecing, and I think Redferns, too. Unfortunately I do not know where to obtain this stuff from larger than 24 in. square, so every wheel over 7 in. or so has to have two joins in each band or tyre. I found this a bit "tyresome" but nevertheless, my engine has a set of scale tyres that are completely satisfactory, and the joins are virtually invisible. This material is only used for the heels of shoes, as it is very hard, and it can be bandsawn, wood-planed, chiselled, filed, sanded, and for our purpose, stuck on with Araldite. The thickness available is usually "10½ iron", an "iron" being 1/48 in. (Probably now gone metric.) So 10½ iron will be just under $\frac{1}{4}$ in., just right for $1\frac{1}{2}$ in. scale with one layer. My 2 in. scale engine needed two layers, as per Figs. C and D, the broad band covering the entire rim (less $\frac{1}{8}$ in. each side) and three narrower bands for hind wheels and only one for front wheels.

I have made the total thickness only 5/16 in. which seems a bit thin, scalewise, but they look right; $\frac{3}{8}$ in. would perhaps be nearer scale but tends to look clumsy. If you can get 9 iron material, then two layers would be exactly $\frac{3}{8}$ in., but if not to one's liking, the material can be planed down with a sharp wood plane. Not, of course, against a stop, but clamped down behind the plane. The shallow pattern on these materials I usually half-remove with a file or garnet paper, the reverse side is usually buffed ready for cementing, but if shiny this must be buffed too, taking care not to get rounded edges (or your joins will be visible) and use a clean brush to remove all dust.

Items needed for the job: Four toolmakers' clamps, a stub axle firmly fixed to bench or in vice, 20 yards of thick cotton string or nylon cord, Araldite and a worn out 6 in. Eclipse Junior hacksaw blade with the teeth half ground off. This is a "comb" for evenly and thinly applying the "glue".

I will describe the process as for a two-layer tyre as Fig. C. Commence by rough filing the rim of



This picture shows the rubber tyres on Mr. Sheppard's showman's engine.

wheel; this if done with a clean, coarse file will provide a key for the "glue" and clean the surface at the same time. Do not then touch the surface if it can be helped. For a 3 in. wide rim, cut a strip of the rubber $2\frac{7}{8}$ in. wide, plane edges to finish $2\frac{3}{4}$ in. square at this stage, not 10 deg. bevelled. Buff up surface if not already done with coarse garnet paper on a block, then carefully make a scarf at each end at least 1 in. long, taking care to keep edges sharp and square; the sharper the edges the more invisible will be the joins. This is best done with a sharp wood chisel, then filed smooth, and to a knife edge. Apply to rim and mark off at each end. Apply the epoxy up to marks and a bit beyond, with the Eclipse blade, after mounting wheel on stub axle.

Apply the piece of tyre to rim and clamp each side at the end. With a piece of 1 in. round bar roll the tyre down to the rim till the other end is reached, and apply two clamps. I do not consider this sufficiently contacted, so this is where the string and tough bit comes in. Tie the string to a spoke just behind one of the first clamps, lead it onto the rubber, and pulling very hard all the time gradually wind the string round and round the wheel, till the whole width of rubber is bound with string. Tie the string to a spoke. The second pair of clamps will need to have been taken off by now as the rubber will have stretched slightly and tended to buckle up. Since doing the job this rather hard way, I have thought up a much less arduous way, and that is by using worm-drive hose clips (Jubilee, or similar) extended by riveting strips of steel to the existing clip. At least four would be needed for a $2\frac{3}{4}$ in. band and two each for the narrower tyres. (I still think the string method will give you better joins.) Having now got part way round one hind wheel, leave to set. Cut another $2\frac{3}{4}$ in. band to fill up the uncovered part of the rim plus overlaps for two scarf joints plus about 3/16 in. This latter will produce a slight bulge at the scarfs, as Fig. A, and is necessary for two reasons, adequate material to work down to correct radius and extra pressure on the joints when bound with the string.

When set and hard, carefully chisel and file the bulges down to correct radius, as Fig. B, and prepare the surface for the next layer, i.e. buff and brush off dust. The three outer bands will need partly preforming before gluing on. Cut a strip just over $\frac{7}{8}$ in. wide for the centre tyre and plane to approximately 10 deg. angle off each edge and file or garnet to finish. Mark two lines in pencil 15/16 in. apart in the centre of the rim. Glue, roll and bind as before, making the bulgy scarf joints as before. The two outer strips need one inner edge planing to 10 deg. and gluing on. The outer edge now requires its 10 deg. angle and this is best done with a sharp wood chisel, held tangentially, then filed. After reducing the bulges to a perfect radius, proceed to apply the same finish all round the wheel; the scarf joints should now be virtually invisible, but if you can just see them a touch of shoe dye or boot polish will help. A small radius can be sanded off the six corners if desired.

BOOK REVIEW

"The Rainbow Route" an illustrated History
by Robert E. Sloan and Carl A. Skowronski
Published by Sundance Ltd., 100 Kalamath Street, Denver, Colorado 80223, U.S.A.
416 pp. Price $35.

This is a comprehensive history of three little narrow-gauge railways which operated out of Silverton,Colorado. They were the Silverton Railroad, the Silverton Northern and the Silverton, Gladstone and Northerly, with an aggregate length of less than 50 miles.

These lines involved steeper grades and tighter curves than any other mountain railroad in North America, save one—the Vintah. They came about mainly through the efforts of one man—Otto Mears, and survived very much as a family business.

The book traces the history of the area from the very earliest days including the story of the various mines and mills in the area, up to the final dismantling in 1938-39.

The whole work is produced on a grand scale; there are no less than 52 colour photographs of excellent quality and innumerable black and white and sepia illustrations. There are also several coloured reproductions of water-colours and many drawings showing the locomotives, rolling stock and buildings.

Produced on high quality paper throughout, this is a remarkable work, which should be of interest to historians and railway enthusiasts alike. There is a comprehensive index and bibliography. R.M.E.

A PLUG-IN SPINDLE

by A. J. S. Baker

SETTING UP time is a problem in any workshop involved in making small numbers of special components and this is particularly the case of the model engineer with limited machine tool capacity.

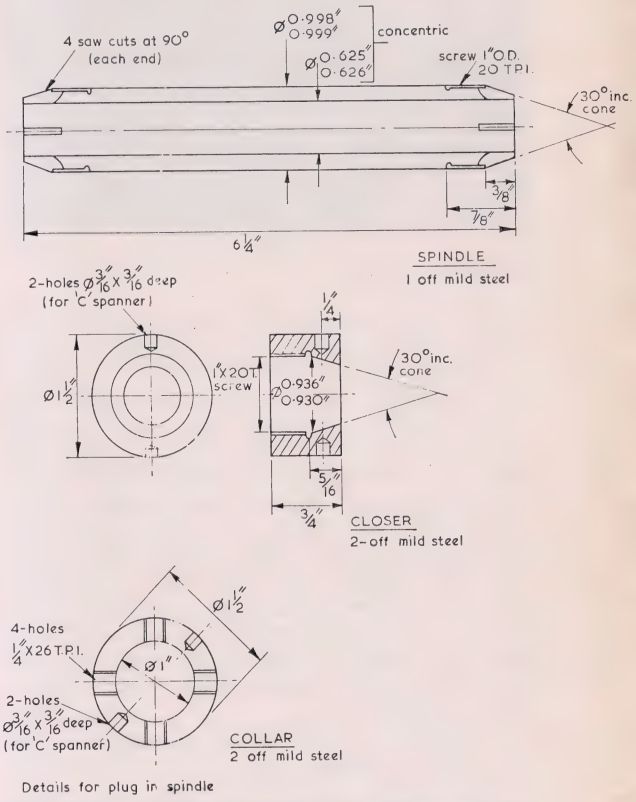
Those people considering the building of a gear cutting machine along the lines being described by Mr. Jacobs may be particularly interested in a workhead spindle with a capacity for rapid setting up. With a plug-in spindle, it is possible to change a cutter without disturbing either bearing adjustment or gear train settings. Alternatively, the gear train may be altered, as in the case of hobbing different sized gear wheels, without touching the hob or cutter.

From the general arrangement it will be seen that each end of the spindle is formed into a simple split chuck capable of holding, firmly, two separate short shanks, of, in this case $\frac{5}{8}$ in. dia. This diameter was chosen as being the same as the bore of Myford change wheels and at the same time is quite stiff enough to avoid excessive deflection with a short hob. If made carefully, it will grip the drive and hob shafts quite securely by clamping force alone, but if this is considered insufficient, a grub screw through the collar will provide a positive radial location. Alternatively the ends of the shafts may be flattened to half-round tangs to engage with each other at a point midway along the spindle bore.

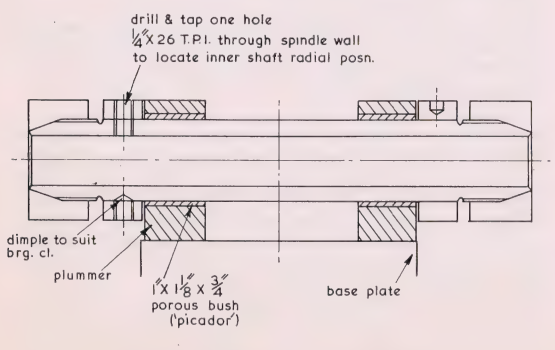
The only point of manufacture requiring care is to get a straight and accurate spindle bore, truly co-axial to the bearing locations on the outer diameter of the spindle. One way to do this is to accurately chuck a piece of bright bar having an outer diameter somewhat greater than finished and drill and bore it as far as possible from one end, to a diameter 1/16 in. less than the finished internal bore. If long drills of the appropriate pilot hole size are in short supply, drill and bore undersize as far as possible from one end, then reverse the blank in the chuck, true it up and drill and bore, still undersize, from the other end. Having thus obtained a through hole, it is then possible to bore this to size from one end at one setting using a long boring bar, say $\frac{1}{2}$ in. dia. in the example shown, with a detachable tool bit.

Having obtained a true, parallel hole of $\frac{5}{8}$ in. dia., finish cut the screw threads and taper off the free end before disturbing the chuck setting. This end can then be split, as shown, and used to clamp the spindle on a truly centred mandrel of $\frac{5}{8}$ in. dia. to enable the outer diameter and remaining taper and screw cutting to be completed between centres, thus preserving the co-axiality of bore and outer diameter.

In use, this spindle will soon accumulate its collection of short stub shafts to hold hobs and cutters, which will rapidly provide means of reducing setting up time to a minimum. A similar spindle arrangement may also be found very useful for the gear cutting workhead and the universal milling head which most model engineers eventually get around to making for milling and keyway cutting in the lathe.



Details for plug in spindle


To hold Ø5/8″ shaft of any length or shorter Ø5/8″ shafts in either end.
drill & tap one hole 1/4″ X 26 T.P.I. through spindle wall to locate inner shaft radial posn.
dimple to suit brg. cl.
plummer
1″ X 1 1/8″ X 3/4″ porous bush ('picador')
base plate

ARRANGEMENT OF PLUG IN SPINDLE

"London's Lost Railways" by Charles Klapper

Published by Routledge & Kegan Paul, Broadway House, Newtown Road, Henley-on-Thames, Oxon.
139 pp. Price £5.50.

This book sets out to contrast the railway scene of the past in the Metropolis, in the heyday of steam, with that of the present day, and suggests some ways of re-establishing lines on which traffic has fallen away.

The possibility of improving the Broad Street–Richmond line is looked at, and the proposal for an Outer Circle of railways to encircle London is discussed.

An interesting proposal for a terminus to combine Euston, King's Cross and St. Pancras—the Abercrombie Report—which included the sweeping away of all three terminii to be replaced by a unified Northern terminus was examined by a Ministry of Transport Railway Committee in 1944 and by the British Transport Commission in 1948. No doubt the immense cost involved has prevented anything being done on these lines. R.M.E.

"SOUTHERN BELLE"

A New Locomotive for Gauge "I"

L.B.S.C.R. 4-4-2 "Atlantic" of class H.2

Part IV

by Martin Evans

From page 756

THE VALVE GEAR for *Southern Belle* is a fairly close copy of that on the full-size L.B.S.C.R. "Atlantics", having the "locomotive type" expansion link and a long valve rod slotted to take the usual suspension lever and with an upwards "set" to allow clearance for the leading coupled axle.

From a purely mechanical point of view, I would have preferred to use the "launch-type" expansion link, as in *Rob Roy* and *Super-Claud,* as it is difficult with the locomotive-type link to keep the eccentric diameter within reasonable bounds.

Looking at the general arrangement of the gear, the forked ends of the eccentric rods seem rather large in relation to that of the valve rod, but the difference is not as great as it appears, and if any builder finds that he cannot quite get the desired full gear valve travel, the eccentric rod forks could easily be reduced to the same radius as that on the radius rod. In any case, I would strongly advise builders not to case-harden any of the parts of the valve gear until the whole gear has been assembled (using temporary pins) and clearances etc. checked. I mention this now because in gauge "I" work, clearances are very fine, and it is not always easy to get components exact to a drawing, while still maintaining sufficient strength.

Perhaps the eccentrics should be made first, so that the driving wheels and axleboxes can be assembled for keeps. Over the flanges, these are 19 mm. dia., so anyone using up his "Imperial" mild steel could use $\frac{3}{4}$ in. stock, as $\frac{3}{4}$ in. is just a few thou. over 19 mm.

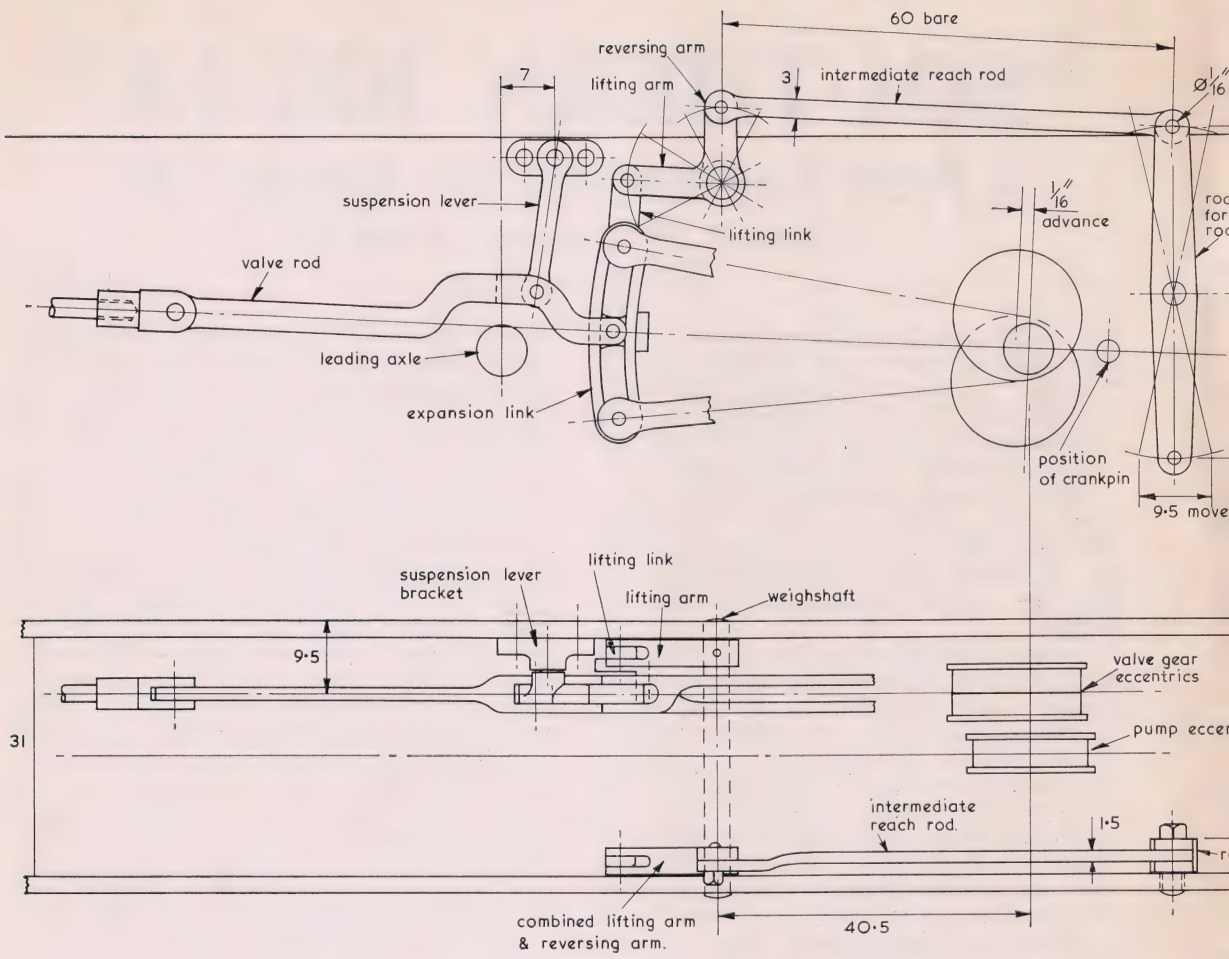
Members of the Gauge "I" Association will recall a very neat jig for machining eccentrics described in their Newsletter, so I would suggest to them that they look up the article before starting work.

The basis of the eccentric jig, which is the work of Mr. Austin K. Clarke, consists of two steel bars, about $\frac{3}{4}$ in. x 3/16 in. in our case, bolted to the faceplate, parallel to one another and 1 in. apart. Between these bars, a piece of steel bar 1 in. x 5/16 in. is allowed to slide. In the top end of this bar, a $\frac{1}{4}$ in. dia. hole is drilled, to take a $\frac{1}{4}$ in. bolt through it, with the head on the back of the faceplate. At the other end of this bar, a hole is drilled and bored an exact fit for the eccentrics, in our case 17 mm. dia. The end of the bar is then split, using a fine saw or a thin slitting saw in the lathe, the slit going into the hole for the eccentric. A pinch bolt is fitted across the bottom of the bar (through the 5/16 in. thickness) so that when an eccentric is inserted, it can be held firmly.

A "datum roller" is now made. This could consist of a 5/16 in. length of 1 in. dia. silver or mild steel, bored $\frac{1}{4}$ in. dia., and this is held by a $\frac{1}{4}$ in. bolt to the faceplate just below the bar holding the eccentrics, using one of the faceplate slots. In between the bottom of the eccentric-holding bar and this roller, a piece of square steel bar about $\frac{3}{8}$ in. is inserted. The eccentric is now accurately centred, using any well-tried method; it is then bolted firmly to the faceplate and the $\frac{3}{8}$ in. bar and the roller pushed up tight against it and the roller also bolted firmly.

All we need now is a bar to replace the $\frac{3}{8}$ in. square bar, that is $\frac{3}{8}$ in. plus the throw of the eccentrics, which in this case is 4.5 mm. The bolt holding the eccentric-holding bar is slackened, and the bar moved up until the new setting bar can be inserted between the eccentric-bar and the datum roller. On clamping the lot together again, we are now ready for the insertion of the first eccentric, for drilling and boring.

The expansion link is made from 3/32 in. gauge plate. I have introduced Imperial dimensions here as I am not sure at the time of writing whether gauge plate in the required metric thickness is available, whereas 3/32 in. can be obtained from Reeves or Whistons. The slot in the links should be made first, and the method described for *Super-Claud* (page 815) can be used. I will be pleased to describe the method in full if any builder wishes. The die-blocks are so short that there is no need to mill them. They can be hand filed in a very short time. The link brackets will have to be silver-soldered to the links, but to make the job easier, one small screw (about 12 BA) can be put through the bracket, into a tapped hole in the body of the link, to hold the two together in correct alignment while the silver soldering is carried out. It will not be possible to harden the links right out, but if they are plunged into thin oil as soon as the "redness" dies away, they will be sufficiently hard for our purpose. The pins for the lifting links are

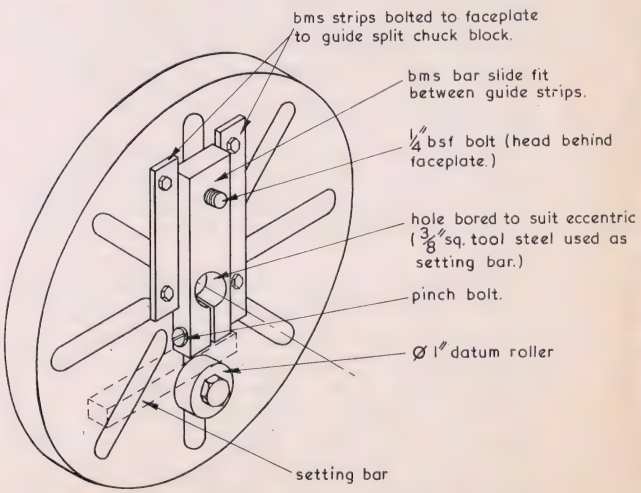


pressed into the link brackets *after* the silver soldering has been completed, otherwise they may work loose with the sudden heating and cooling. As no other fixing can be provided in the available space, it is most important that they don't work loose in service.

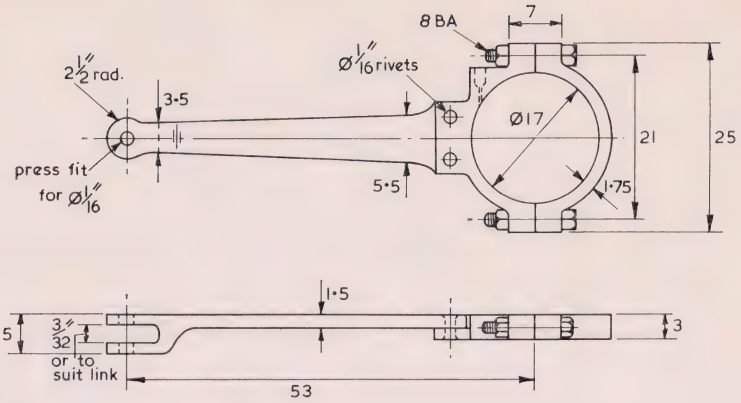
Some difficulty might be experienced in making the valve rods. The important thing to remember is not to try to bend these after drilling and slotting for the expansion link; this will almost certainly lead to trouble. The way I would go about it would be to first file or mill down sufficient square mild steel bar to 5 mm. square section. Then put all the bends in. This should be possible without having to heat the metal at all.

Having achieved reasonable bends, mark out for the three holes and drill them a shade undersize. Next mill out the 3/32 in. slot, using a face cutter if possible. Radius the end of this slot as shown. Then thin down the front end of the rod to a uniform thickness of 2 mm. Finally radius both ends and drill the holes to size, remembering that

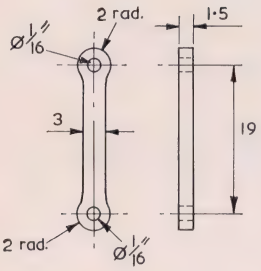
LAYOUT OF VALVE GEAR


bms strips bolted to faceplate to guide split chuck block.
bms bar slide fit between guide strips.
1/4 bsf bolt (head behind faceplate.)
hole bored to suit eccentric (3/8 sq. tool steel used as setting bar.)
pinch bolt.
Ø 1" datum roller
setting bar

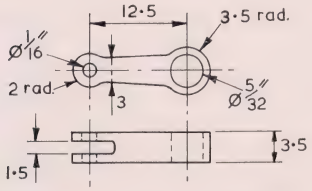
ECCENTRIC MACHINING FIXTURE



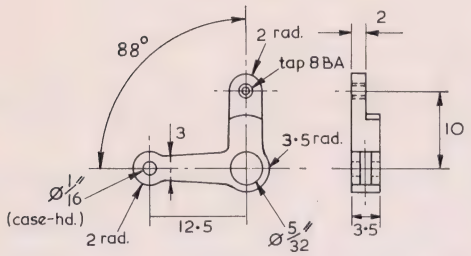
ECCENTRIC ROD & STRAP: rod b.m.s. strap g.m.



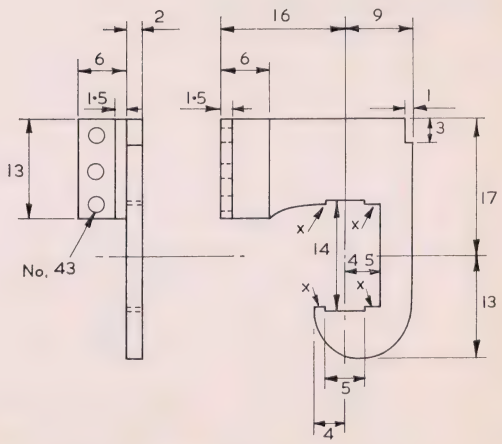
LIFTING LINK: 2 off b.m.s. case-hd.



LIFTING ARM — RHS only case-hd. small end only

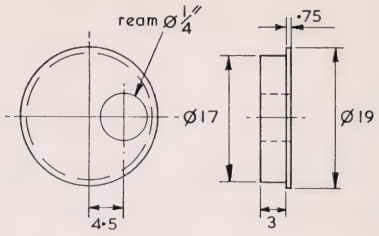


COMBINED LIFTING ARM & REVERSING ARM
LHS only

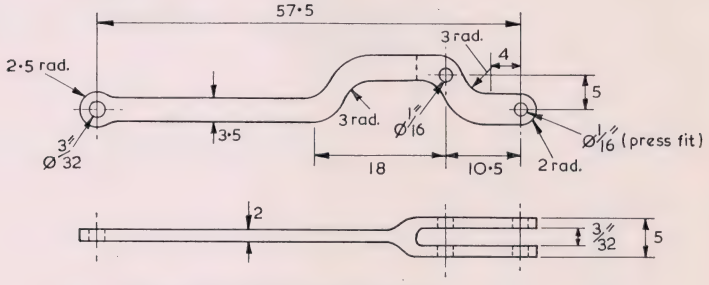


MOTION PLATE: b.m.s. (L.H. drawn)

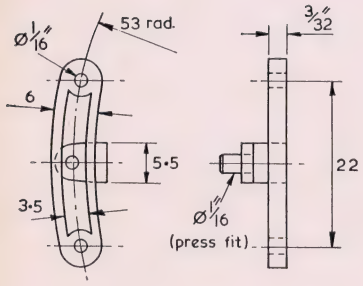
x to clear crosshead

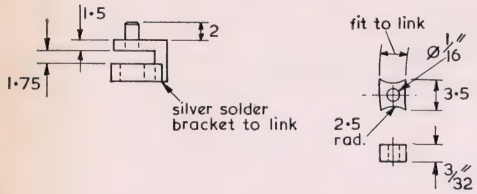


VALVE GEAR ECCENTRIC: 4 off silver steel or b.m.s.

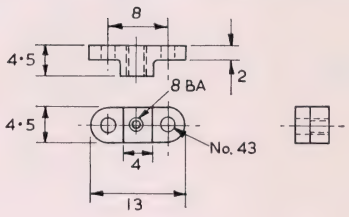


VALVE ROD: 2 off b.m.s. case-hd.

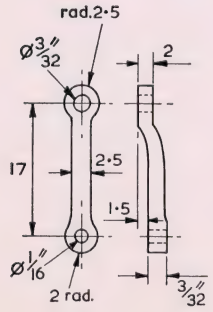




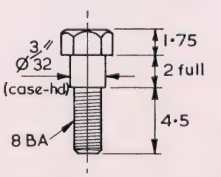
EXPANSION LINK & DIE-BLOCK:
2 off gauge plate



SUSPENSION LEVER BRACKET: 2 off b.m.s.



SUSPENSION LEVER:
2 off case-hd b.m.s.



PIN for SUSPENSION LEVER BRACKET:
2 off steel

the hole at the front end is 3/32 in. dia., and that for the die-block is a press fit size for a 1/16 in. dia. pin.

Returning now to the eccentrics, the eccentric rods can be cut from $\frac{3}{8}$ in. x $\frac{1}{4}$ in. b.m.s., if no close metric size is available. File or mill this down to 5 mm., drill the holes and slot 3/32 in. as before, for the expansion link, then shape the outsides. The eccentric rods are riveted to the straps with two 1/16 in. iron rivets (though copper would be strong enough here if preferred) countersunk lightly on both sides.

The eccentric straps can be made from gunmetal castings, or cut from bronze bar. If castings, after the usual cleaning up with files, drill the lugs right through No. 50, saw the casting in half, using a fine hacksaw, or better still, a jeweller's coping saw as this removes much less metal, clean up the faces left by the saw, then tap the lugs in the front half 8 BA. Screw the two halves together and chuck in the four-jaw with the hole running as truly as possible. Face the side of the strap and

bore out to a nice working fit on the eccentrics. These being single flanged, means that they can be "offered up" to the strap while still in the chuck. To face the other side of the strap, the four-jaw can be used again, or better still, a short "mandrel" can be turned in the lathe, from a piece of mild steel, to the same diameter as the eccentrics, and the strap held on this by screws through the jugs; a piece of thin paper between strap and mandrel will prevent the strap from slipping.

A simple jig should be made up to ensure that all the eccentrics are exactly the same length—very important with Stephenson valve gear. A suitable jig has been described many times in *M.E.* recently, but if any builder would like details, I will be happy to oblige.

The remaining parts of the valve gear should not present any difficulties. The suspension lever brackets can be quickly cut from 3/16 in. square b.m.s., or the nearest metric equivalent. The right-hand lifting arm is a simple item, but the left-hand one is rather unusual, as owing to limited space, I had to combine this with the reversing arm, to which is attached the intermediate reach rod. It is slightly more difficult to make, but the lifting arm part of it is of course identical to the right-hand arm.

The motion plates are cut from 2 mm. or 3/32 in. b.m.s. sheet, and are held to the frames by a length of steel angle 6 mm. x 6 mm. or $\frac{1}{4}$ in. x $\frac{1}{4}$ in. Don't be tempted to use brass here even though this may be more readily obtainable. Steel is much stronger and looks better on the outside of the locomotive. If angle of the required thickness cannot be obtained, it would not take very long to file or mill it down from something thicker, or even mill the angle from $\frac{1}{4}$ in. square b.m.s. Only 13 mm. for each side is required. Builders should take care to cut the slots for the ends of the slide bars in the correct position. To ensure this, temporarily clamp the cylinder to the frame, attach the slide bars, one at a time, line them up parallel to the frame, and measure between slide bar and frame with a small pair of calipers, or with strips of steel used like feelers.

The motion plates are held to the frames by three 8 BA hex-head screws. To line them up and at the same time line the cylinders up with the driving axle, first make sure that the latter is in the correct running position, which can be obtained from the drawing. Turn one end of a length of 3/16 in. dia. silver steel to a sharp point, and centre and drill the other end of it a nice fit for the piston rod. Pull the piston rod out, with the cylinder lightly held in position in its slot in the frame, and push on the silver-steel "pointer", lining this up with the centre of the driving axle. If the slot in the frame does not allow the cylinder to take up its correct position, it can be quickly eased out with a file.

"SOUTHERN BELLE" DRAWINGS

Now available: L.O. 948. Sheet 1: General arrangement and frames. Sheet 2: Buffer beams, driving wheels and axles, full details of cylinders, crossheads, slide bars, coupling and connecting rods.

Price 85p each.

BOOK REVIEWS

"Britain's Railways in the Seventies"

Published by Ian Allan Ltd., Terminal House, Shepperton. 80 pp. Price £2.

This is a collection of pictures from photographs taken all over the British railway system, from Penzance to the Scottish Highlands. While most of the trains depicted are diesel or electric, some of the many steam locomotives which have been preserved are also shown.

Freight traffic has not been neglected, nor has the new High Speed Train. R.M.E.

"Steam Engines and Waterwheels". A pictorial study of some early mining machines

by Frank D. Woodall

Published by Moorland Publishing Co., The Market Place, Hartington, Buxton, Derbys. Price £3.50.

In recent years there have been several books published on the mines in Cornwall, the Pennines, Wales, etc., but these have dealt mainly with social and economic matters. In this new work, the author describes the equipment used.

Chapters include "Before the days of steam power"—dealing with man and horse-power and early waterwheels, "Primitive steam power"—Newcomen engines, "The Cornish engine", rotary engines, vertical winding engines and ventilating fan engines.

Nearly all the illustrations are from Mr. Woodall's own negatives and several of his historical engines are shown.

The book is well produced on fine quality paper and is moderately priced. R.M.E.

"The Steam Scene". Volume I

by R. J. Blenkinsop

Published by Steam Engine Publications, 78 Southern Road, Radford Semele, Nr. Leamington Spa, CV31 1VA. 94 pp. Price £2.95 plus 25p pkg.

This is a collection of black and white photographs of traction engines, steam rollers, showman's engines, ploughing engines and steam wagons taken mainly at rallies during the last few years.

The illustrations are all of very good quality. R.M.E.

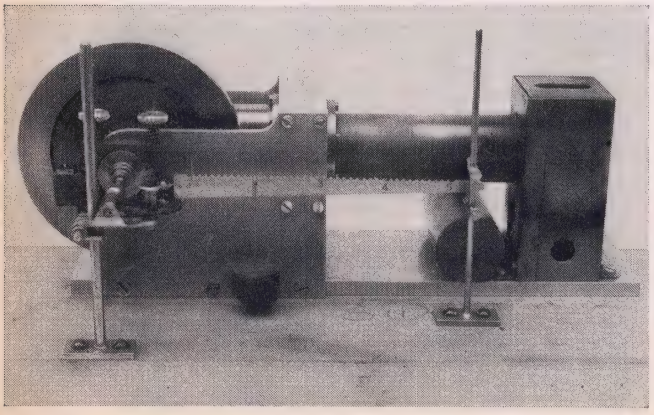
THE HOT AIR ENGINE COMPETITION

by Prof. D. H. Chaddock CBE

AS A DRESS REHEARSAL for the Hot Air Engine Competition which, as already announced, will be held at the 1977 Model Engineer Exhibition, the donor of the prizes, Mr. A. N. Clark, very kindly offered the loan of one of his engines so that the method of testing could be developed and any snags overcome. An account of the brake that will be used and the method of testing will, it is hoped, be of interest to readers, if it enables them to tune-up their own engines before entering them for competition.

A photograph of Mr. Clark's engine running under load with the brake and revolution counter attached is shown in Fig. 1. A flanged drum 11/16 in. dia. is attached to the standard 5/32 in. dia. x $\frac{3}{4}$ in. long output shaft and a load is applied to it by means of two hardwood friction shoes pressed together by means of adjustable compression springs. The torque exerted by the shoes on the drum is measured by an arm, accurately notched at 0.1 in. intervals, and loaded by a rider and weights—the distance along the arm multiplied by the weight lifted giving the torque which the engine is exerting. The drum also drives, through a short extension shaft with universal joints each end, a revolution counter which has a fine tooth count wheel driven by a single start worm. The count wheel runs continuously and the time for a specified number of revolutions, usually 3 or 5 depending on the speed at which the engine is running, is taken with a stop watch. From this the speed in revolutions per minute can be readily calculated and taken in conjunction with torque, enables the horse-power at that speed to be calculated.

Fig. 1: Mr. A. N. Clark's engine lifting $\frac{1}{4}$ oz. at 2 in. radius at 990 r.p.m.



The torque arm, shown in more detail in Fig. 2, is a development of one previously used very successfully by the writer in testing a model gas turbine, albeit at much higher power and speed. The drum is turned from mild steel and has two flanges, rather like a locomotive eccentric, 1/32 in. wide by 1/32 in. high each side to keep the brake shoes in place. But unlike an eccentric it must run as true as possible and the centre hole must be reamed otherwise the end of the long torque arm will shake about badly and make accurate reading impossible. For low powers the drum need not be hardened, but should be polished to supplement

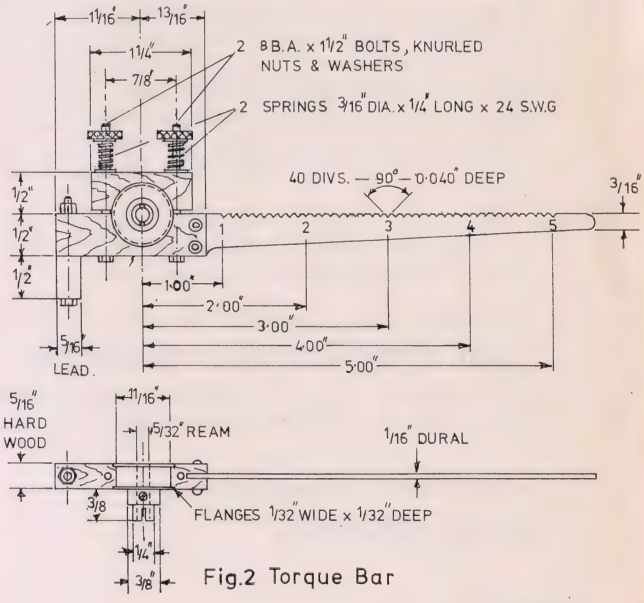


Fig.2 Torque Bar

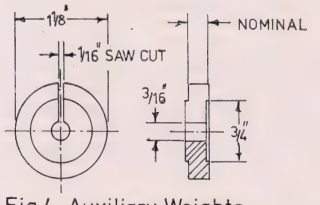


Fig.4 Auxiliary Weights

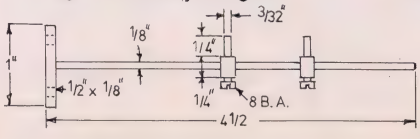


Fig.5 Stop Bar

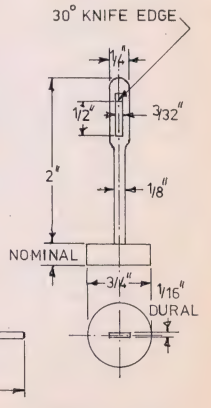


Fig.3 Rider

the burnish it will acquire in use and to prevent unnecessary wear of the brake shoes. The brake shoes can be made from any hardwood — oak, beech or mahogany seem to work quite well, but the centre hole must be cleanly bored, not with a carpenter's bit, so lightly glue the two shoes together and bore the centre hole with the work held in a 4-jaw chuck in the lathe. It should, if anything, be a rather slack fit on the drum so that the horns do not bind and a spot of oil is conducive to smooth running without impairing the frictional properties. The holes for the 8 BA bolts may be a tight fit in the lower shoe to prevent them turning, but the holes in the upper shoe should have ample clearance so that the pressure of the loading springs is not influenced by friction or jamming.

The lever arm is notched into the lower shoe and secured by two 1/16 in. rivets, with washers to prevent the wood being crushed. For jobs like this the writer finds it convenient first to secure the parts in place with quick setting adhesive (e.g. "Miracle Bond" bought at last year's Exhibition) before marking out, drilling and riveting. The really important thing about the torque arm is the accuracy of the notches which locate the rider and so measure the effective length of the lever arm. They can be marked out and filed, but the writer milled them in the Dore-Westbury miller using a sharp pointed 90 deg. engraving cutter and indexing the work by means of the table feed screw. It is important too that the distances are as accurate as possible measured in relation to the geometric centre of the drum so that while the shoes are still in the 4-jaw chuck and after boring it is well to scribe an accurate centre line across them to serve as a reference mark for the subsequent milling operation.

When all is finished, the torque arm must be balanced by mounting it firmly on the drum which in turn has a 5/32 in. silver steel shaft in it rolling on knife edges. If all the parts are kept as light as possible, and the prototype brake weighs, complete with balance weight, $\frac{3}{4}$ oz., it can be balanced by a block of lead about 5/16 in. x 5/16 in. x $\frac{1}{2}$ in., but in any case make it oversize at first and file it down until the upper surface of the torque arm comes to rest exactly horizontal. With the balance weight mounted as shown below the shoe the brake has a good deal of positive stability which makes for steadiness in running, but the sensitivity can be increased by mounting some portion of the balance weight above the shoe, though the writer does not recommend a neutral balance with a brake of this sort.

The rider shown in Fig. 3 is adjusted so that its total weight is exactly $\frac{1}{4}$, $\frac{1}{2}$ or 1 oz. as the case may be. If the disc is mild steel it will be approximately $\frac{1}{4}$ in thick. for $\frac{1}{2}$ oz. and twice as thick for 1 oz. In light alloy $\frac{1}{4}$ oz. will be about $\frac{1}{4}$ in. thick but in any case make them over-size at first and then when assembly is complete skim light cuts off the bottom until they are dead to weight. If you overdo it a dab of solder on the bottom will restore the missing milligrams. The inner and upper edge of the slot in the bridle should be filed to a sharp knife edge so that it locates accurately in the notches in the torque arm and hangs free without any friction or binding. The auxiliary weights shown in Fig. 4 are slotted so that they can be slipped on the rider and spigotted so that they rest on the rider and on one-another. For mild steel the nominal thickness for $\frac{1}{2}$ oz. is $\frac{1}{8}$ in. and for 1 oz. $\frac{1}{4}$ in. but again make them oversize in the first place and reduce them to weight with light cuts when all other machining is finished. For weighing a good letter balance is adequate, but a laboratory balance would be better, remembering that 1 oz. equals 28.35 grams. In fact in these days of metrication the whole thing should have been made in metric units with the torque arm 125 mm. long, notched at 2 mm. intervals, and the rider and weights calibrated in Newtons. It would in fact have made the calculation of the power, in Watts, very simple, but for the present the measurements are made in Imperial units and the conversion made arithmetically.

The final piece of equipment is the stop bar shown in Fig. 5. It is mounted so that it engages the extreme end of the torque bar and the pins set so that the torque bar has about $\frac{1}{8}$ in. travel up and down from the truly horizontal position. In use the friction of the shoes is adjusted until the end of the torque bar is just floating midway between the upper and lower stops, as may be seen in Fig. 1 and in which condition a reading of the engine speed may be taken.

Considerable thought and some experimentation was given to the best method of recording the speed. A stroboscope would be ideal, but unless it were crystal controlled or frequently re-calibrated not reliable enough for a Competition. Tachometers suffer the same disadvantages plus the added one of introducing extra and unmeasured friction

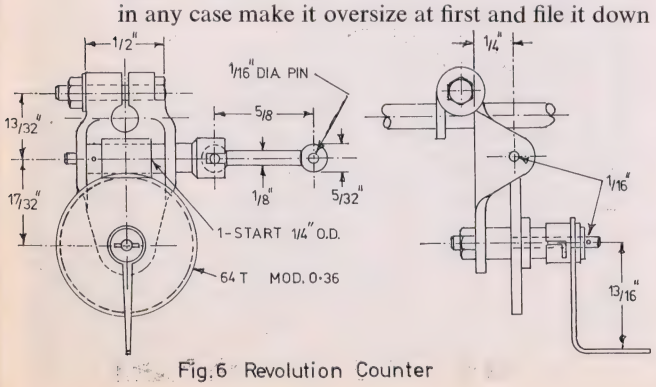


Fig. 6 Revolution Counter

which, in these tiny engines, might absorb a considerable proportion of the power output. A revolution counter of the "Veeder" type, although it had seen considerable use and was very free running, was also found to have too much friction so eventually the very simple count wheel shown in Fig. 6 was made up and imposes negligible friction on the engine—in any case it will be the same for all engines and in that sense the competition will be "fair".

The basis is a fine tooth clock wheel, actually an hour wheel still mounted on its cannon, having 64 teeth, module 0.36—approximately 70.55 D.P.—and a pitch circle diameter of 23.04 mm. The bore of the cannon was bushed down with short bushes each end to 1/16 in. dia. further to reduce the friction. It runs on a dead arbor which can be moved laterally to adjust the depth of engagement of the teeth and kept in position by the classical clockmaker's washer and cross pin. The meshing worm is single start, $\frac{1}{4}$ in. o.d. and hardened and polished to reduce friction. The theoretical pitch for Module 0.36 is 22.45 t.p.i. but a worm cut with 22 t.p.i. seems to mesh adequately. The worm is mounted on a 1/16 in. dia. silver steel spindle to which it is secured with a cross pin and is driven from the drum by a short extension shaft having 5/32 in. ball and socket joints at both ends. This not only makes alignment easy but eliminates any binding or friction which might result from residual misalignment either on the engine crankshaft or the worm spindle. The whole thing is extremely free running, it can literally be blown round, and makes no perceptible difference to the engine speed. A pointer on the count wheel cannon is arranged to pass close to the vertical column supporting the counter and serves as a zero mark when counting the number of turns.

To save a lot of work the frame carrying the gears was bent up from sheet metal. Here it is the writer's practice instead of marking out the shape first in the flat and then trying to bend to the lines to do the bending first and the marking out afterwards. Fig. 7 shows the sequence of operations, starting with a piece of metal which is well oversize in all dimensions and concentrating on getting good clean bends. Odd ends of square and rectangular bright mild steel are very useful for this, but do please put an ample radius on any internal corners, at least equal to metal thickness and preferably more. When stage 3 is reached one can concentrate on getting everything square and shipshape before marking out from the already bent edges just as if it were a small casting or fabrication. The trick of turning sheet metal back upon itself to accommodate a clamping bolt, cross drilling and slitting is a much better way of providing a sheet metal clamp than the customary pipe clip bent out of sheet metal along its thickness. A close-up of everything in position and ready for running is shown in Fig. 8.

In using a brake of this type it is much easier to set a given load on the torque arm and then to measure the engine speed than to endeavour to run the engine at a set speed and to measure the torque at that speed and the results when plotted in the form of a speed-power graph give the same curve. In setting the torque it does not matter, within the limits of which the engine is capable, what weights are used since 1 oz. at 1 in. is exactly equivalent to $\frac{1}{2}$ oz. at 2 in. or $\frac{1}{4}$ oz. at 4 in. and so on. However, in order to extend the scale it is usually best to choose a weight which the engine can lift when it is towards the outer end of the torque arm. Only when one is seeking the maximum torque that the engine will pull need one shift the weight along one notch at a time, adjusting the friction of the shoes at each setting so that

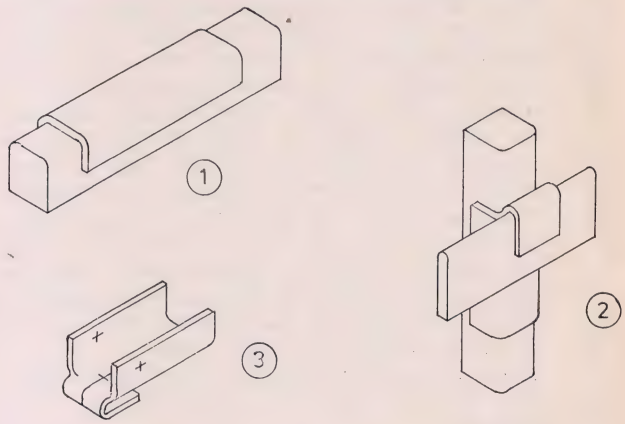
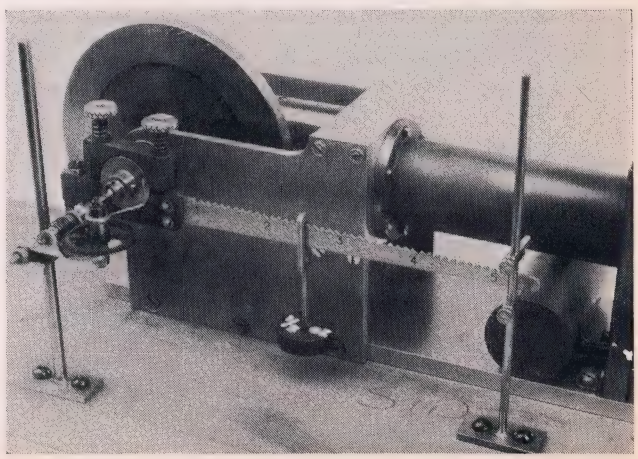


Fig.7 Stages in bending

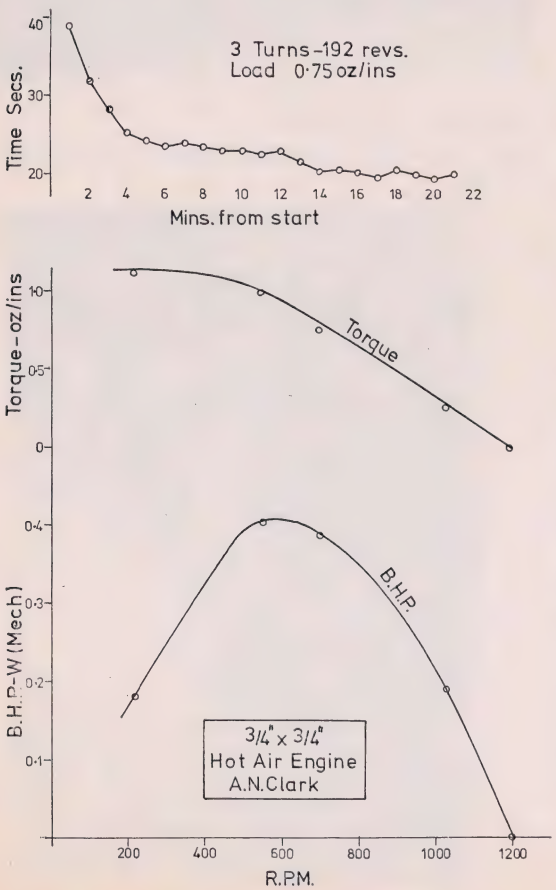
Fig. 8. The friction brake and rev. counter set up for a load of 1.25 oz./in.



the torque arm floats, until the engine is on the point of stalling. The speed may then be recorded with count wheel and stop watch.

The results of a typical test run on Mr. Clark's engine are shown in Fig. 9. First an investigation was made into the constancy of the speed and the optimum time that a run should last. After the engine had warmed up, a load of 0.75 oz./in. was applied to the torque arm, $\frac{1}{4}$ oz. at 3 in., and held constant throughout the test by adjusting the pressure on the shoes. The engine was timed every minute for 3 turns of the count wheel, 192 engine revs by stop watch and the times recorded. Initially the times were very poor, nearly 40 seconds for 192 revs, but after 5 minutes running the time seemed to have settled down to an average of 23 seconds. This was held for some 12 minutes from the start of the test when there was a sudden improvement and the time dropped to 20 seconds with two readings less than this until 21 minutes total running time when the test was stopped. To get a fair result it was decided to take the average of the three best readings, namely 19.4, 19.8 and 20.0 seconds equal to 19.73 seconds which for 192 engine revs gives a speed of 192 ÷ 19.73 × 60 = 584 r.p.m.

Fig. 9



To get the horsepower it is necessary to use the standard formula:

$$\text{H.P.} = \frac{2\pi NT}{33{,}000}$$

but as the units are rather large for model work and the engine will not generate one H.P. anyway it is convenient to convert the formula into one which gives the power in Watts (746 Watts = 1.0 H.P.) and in which the torque is measured in oz./in. This comes out to be:

$$\text{Power in Watts (mechanical)} = \frac{\text{Revs. per minute} \times \text{Torque in oz./in.}}{1352}$$

Applied to the previous result therefore the power was 584 × 0.75 ÷ 1352 = 0.32 Watts.

This proved however not to be the best performance of which the engine was capable but repeated testing at loads of 1, $\frac{3}{4}$, $\frac{1}{2}$, $\frac{1}{4}$ oz./in., no load and a special test where the load was increased to the maximum which the engine would pull produced the power and torque curves shown in Fig. 9. From this it will be seen that the maximum power is 0.41 Watts at 600 r.p.m. This is about half the free speed of the engine and shows how little value there is in measuring the free speed since at this speed the engine is developing no power whatsoever. The maximum torque is 1.125 oz./in. developed at 200 r.p.m. which is about one-third of the speed for maximum power, again a reasonable result. Students of engine design will be interested to know that this is almost exactly equivalent to a brake mean effective pressure of 1.0 p.s.i., surely the lowest that has ever been recorded in an engine test. This very low value and the very rapid fall-off in the power curve show that there is indeed scope for improvement of the hot air engine and it is to be hoped that some at least of the engines in the competition will show much more than the very modest 1/2,000 of a horsepower recorded in this dress rehearsal.

Finally a word about the limit of capacity chosen for this competition. It has been put to the Editor and the writer by experienced engine builders that a 5 c.c. limit is really too small for an engine to produce any useful power. Maybe at the present state of the art it is, but Mr. Slack, Mr. Urwick, Mr. Thomas and Mr. Ross have all shown that hot air engines can be developed to give useful powers and Dr. Senft has demonstrated an even smaller one of only 0.9 c.c. capacity. So it puts a premium on good workmanship, itself part of the competition. Engines of this size are cheap to build and modify and present a real challenge to readers

which it is hoped will be taken up. Although a round 5 c.c. was chosen to come in line with International I.C. engine standards it is unfortunate that it theoretically excludes engines with the popular size of $\frac{3}{4}$ in. bore x $\frac{3}{4}$ in. stroke because this represents a capacity of 5.43 c.c. However I have the authority of the Organisers to announce that engines not exceeding the competition limit by more than 10% will be accepted, but that their measured power will be reduced by the amount that they exceed that limit, that is to say a $\frac{3}{4}$ in. x $\frac{3}{4}$ in. engine would have its recorded power reduced by 7.9% in assessing the awards. For new engine builders $\frac{3}{4}$ in. bore x 11/16 in. stroke and 23/32 in. bore x $\frac{3}{4}$ in. stroke both come within the 5 c.c. limit. $\frac{5}{8}$ in. bore x 1 in. (bare) gives a convenient long stroke engine and $\frac{7}{8}$ in. bore x $\frac{1}{2}$ in. stroke a short stroke one. Double acting or twin cylinder engines could be made 9/16 in. bore x $\frac{5}{8}$ in. (bare) stroke—still much larger than Dr. Senft's engine which could be a 6-cylinder and still come within the terms of the competition.

Finally, the Organisers and the S.M.E.E., on whose workshop stand at the Exhibition the competition will be run, extend an open and cordial welcome to any engine builder to bring his engine to the Exhibition where it can be shown, run and tested even if it is not eligible for one of the prizes.

New track at King's Lynn

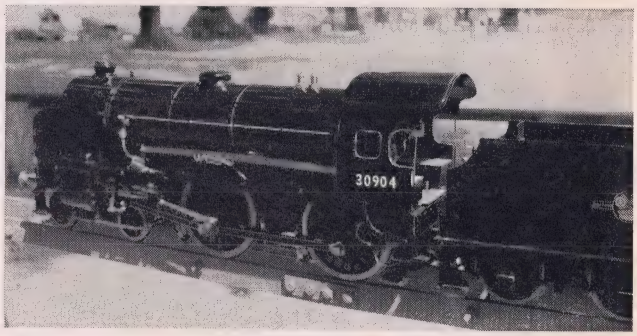
D. E. Lawrence

IT IS ALWAYS GOOD to hear of a new track being built and even better to be invited to the Opening. King's Lynn D.S.M.E. was formed as recently as 1970 and there are now about 90 members in two strong sections—marine and engineering. The marine section has a water for their activities and now the engineering section has a 712 ft. continuous track in the Walks, which is a park in King's Lynn.

Construction of the track is of concrete pads set at ground level with concrete piers on these at 5 ft. intervals; the rail is fastened by plates to the top of the piers. The steel rail is quite substantial, $\frac{3}{8}$ in. by $1\frac{1}{2}$ in. section and is for $3\frac{1}{2}$ in. and 5 in. gauges; tubular spacers and through tie bolts hold the rail to gauge. The rail strength is such that no beam is provided under it and, as a consequence, running on it is rather noisy. There is no anti-tipping rail fitted. Six steaming bays serve the track with an over-line plate type traverser giving access to the main line. The Society hopes to be able sometime in the future to provide additional services such as water to the site; at present it has to be brought along in containers.

The formal opening on Saturday 5 June last was by the Mayor, Mrs. Betty Barton, who cut the tape after a

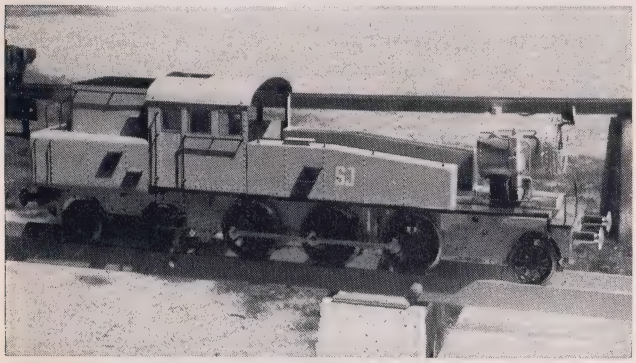
Harry Mallett's "Simplex" in action.



A nice $3\frac{1}{2}$ in. gauge three-cylinder "Schools" class locomotive by Harry Mallett.

Below: The Mayor takes a ride behind Robin Gilding's "Maisie".

suitable speech. The Society received a good deal of help from a local firm and a senior member of the firm, Mr. R. Daniels, was presented with a model beam engine made by some of the members as a token of gratitude; a very nice gesture I thought. The Mayor was persuaded to have a few fast laps behind Robin Gilding's 3½ in. gauge Atlantic *Maisie*. Being surprised at the capabilities of such a small engine, Chairman Jerry Bullock spent some time with her explaining the mysteries of "live steam". The formalities concluded, the Mayor and all the assembled guests were entertained to tea (on the house) and the kiddies were given free rides behind Harry Mallett's excellent *Simplex*.



Chairman Jerry Bullock presents a model beam engine to Mr. R. J. Daniels (seated right).

Left: A ¾ in. scale Swedish 2-6-4T being built by Harry Mallett.

Guildford's Steam Meeting and Exhibition

reported by D. E. Lawrence

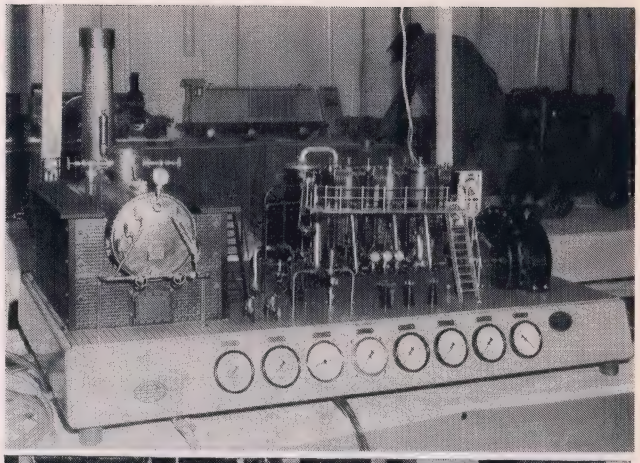
THIS VERY POPULAR EVENT, held on a week-end in July, attracted a sizeable overseas interest and a large attendance from home. Besides offering facilities for guests to run on the newly extended track, a big marquee held a quite extensive exhibition of models. To my eye, the most impressive model there was Rolf Burkhardt's generating plant. The boiler was gas fired and supplied a triple expansion steam engine coupled to a three-phase generator. The engine appeared to be about 1 in. x 1¼ in. x 2 in. bores and perhaps 2¼ in. stroke—I had to guess this as full details of the engine were not given. The builder had arranged the output to light several dozen small electric bulbs forming the letters of his club — D.B.C. Herr Burkhardt comes from Vannweil, West Germany.

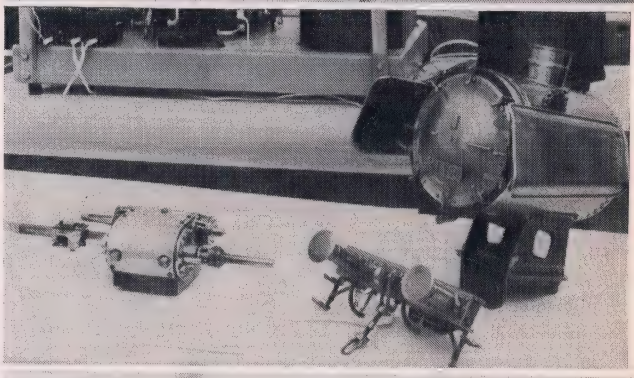
There was a strong locomotive interest accounting for a good third of the models on show. A 5 in. gauge G.W.R. "King" was shown almost complete; plenty of detail on it but the chimney and *top hat* bore little of the Swindon character of these two important items. Next to the "King" was another G.W.R. 5 in. gauge 4 6-0, one of the "Court" series of the two-cylinder 29XXs bearing the name *Titley Court*. Again the chimney and safety valve bonnet lacked the authentic Swindon appearance; this model belonged to Guildford member Norman Dobson. David Neish's 5 in. gauge *Lion* was a very nice-looking job and it was accompanied by a brief explanation of the original gab motion and the builder's more modern valve gear arrangement fitted to his locomotive. An interesting thing about this *Lion* was that the finish was neither too bright nor too dull and it looked just right. The 0-4-2 was awarded the Hodgkiss Trophy for the best model in the Exhibition; your Editor, Martin Evans, did the judging.

I have mentioned before in these pages the possibilities to which LBSC's *Mona* lends itself and one was shown in the (appropriately) LBSC Railway guise of a 0-6-2 Billinton tank. It was also by David Neish and it was plain and neat and finished in yellow livery; the lettering *Boxgrove* on the tanks was nicely done. G. A. Wildschut of Utrecht, Holland, had a narrow gauge 0-4-0T in 3½ in. gauge on show. The builder gave its details as a model of a prototype by Ducroo and Brauns; cylinder size appeared about the same as *Juliet*. Later, this picturesque little locomotive, *Maaike*, was seen running sedately and quietly on the track. Another overseas visitor displayed a smokebox, front buffer beam and cylinder assembly of a Baureihe 41cl. 2-8-2 Guterzuglokomotiv (i.e. goods). Herr Manfred Knupfer, whom I met last year at Chingford, is making a well detailed job of his engine and has had to fabricate many of the parts. This should be a powerful 5 in. gauge engine when finished; the full size had cylinders of 520 mm. by 720 mm. and it was almost 24 metres overall length.

There were general engineering models and tools in the show, too numerous to mention here, and in addition a substantial amount of fairground and showmen's models of which the group by C. E. and E. F. Orchard was perhaps the most colourful and picturesque. This father and son team from Princes Risborough had made a representation of an old Buckinghamshire fair, complete with gallopers, big wheel, side shows, showman's engine and the "courthouse" in the square. The models did not appear to be all to the same scale, but nevertheless the whole was an attractive reminder of the heyday of the travelling showman. Before I leave the Exhibition, I ought to mention a rare model of a G.W.R. 1661 saddle tank.

Happy Luc Tenstedt prepares his 1½ in. scale "Highlander" for duty.





Right (reading down):

A very fine model generating plant by Rolf Burkhardt from W. Germany.

Parts for a German 2-8-2 locomotive by Manfred Knupfer.

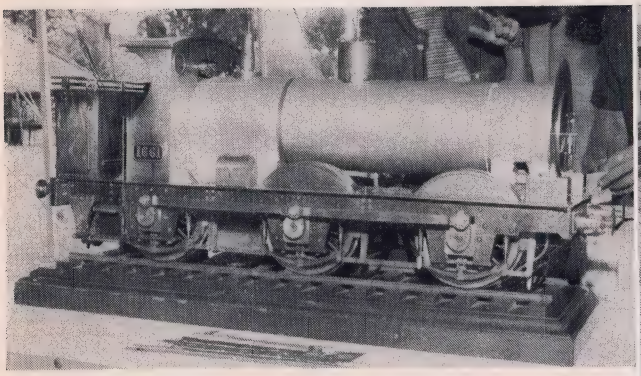
The cup-winning "Lion" by David Neish.

5 in. gauge 2-8-2T "Margret" by Herr Wolfgang Schüller.

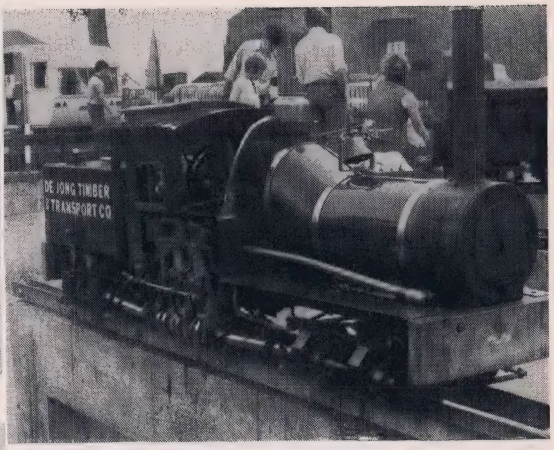
This was shown by Geoff Moore, it is not all his own work having been started by Ernie Powell; it needs saddle tanks and a few other items to complete it. The engine has the real old *Dean* Great Western character and it will be a pleasure to see it running when finished.

Out on the newly extended track the overseas visitors were thoroughly enjoying themselves. The most striking looking visiting engine was Herr G. De Jong's 5 in. gauge *Shay* which has three Stuart vertical engines fitted driving through the usual rods and gearing arrangement to the two motor bogies. Mr. De Jong comes from Drachten, Holland, and spent a long time on the track. Arnold Kaliwoda of West Berlin used to see an East German Railway's 4-6-2 0-1 class express engine trundle past his window every day, so he built one in 5 in. gauge. Cylinder size is similar to the DB class 41 mentioned earlier and there is a Giesel ejector chimney; the boiler is all welded steel and has a combustion chamber. The engine has Troffinoff piston valves.

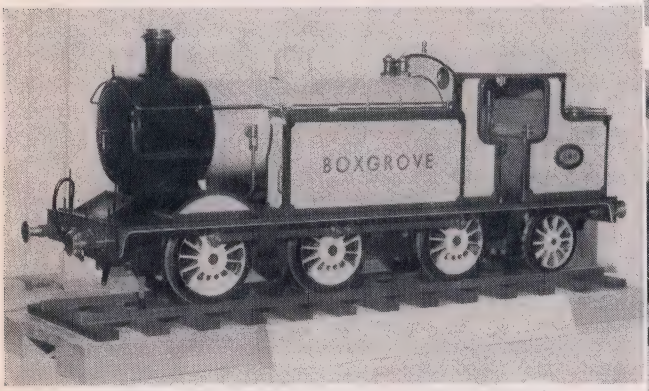
Manfred Knupfer, in addition to the locomotive parts in the Exhibition, also had his DB 55 class 0-8-0 goods engine on the track. He told me it was built in



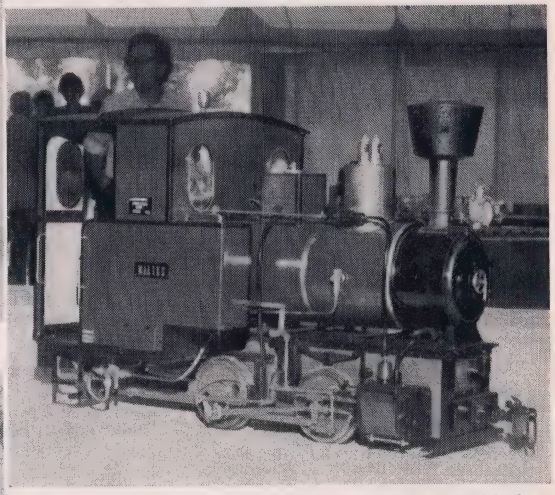
Geoff. Moore's G.W.R. saddle tank (unfinished)



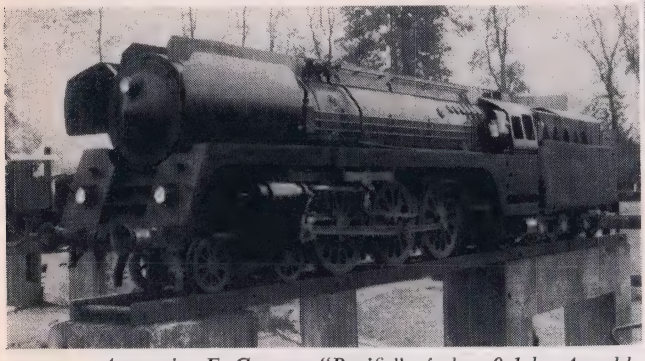
G. De Jong's Stuart-engined "Shay".



A "Mona" in Brighton livery by David Neish.



A quaint narrow-gauge 0-4-0T by G. A. Wildschut, from Utrecht.



A massive E. German "Pacific" of class 0-1 by Arnold Kaliwoda of West Berlin.

1968 and was the first 3½ in. gauge locomotive built in West Germany and has made previous visits to this country. I was pleased to renew acquaintance with Luc Tenstedt, a Belgian model engineer, who again brought over his 1½ in. scale L.M.S. class 5 *Highlander*. This engine is for 200 mm. gauge, a circumstance Luc now rues, and a specially made length of track was put down on which it ran. Luc offered me a drive of *Highlander* and I found it a gentle giant, well mannered and responsive; it is fitted with compressed air brakes and these were effective and had a good degree of control as I found when backing up with a little steam on and a touch of the brake to stop at the right spot. Luc also has a 1½ in. scale *Royal Scot* to the same 200 mm. gauge.

An interesting locomotive is Wolfgang Schüller's 5 in. gauge 2-8-2T *Margret*; this is a freelance engine based on a metre gauge prototype and, in 5 in. gauge, is a hefty job. The boiler extends almost to the back of the cab which is so shaped as to allow unrestricted access to the firehole door. Although appearing rather top-heavy, the engine ran very steadily on the track. Herr Schüller comes from Cologne and was one of the strong contingent of West German model engineers. Dr. Erich von Gumpert came over two years ago with his *Big Lady* and he was enjoying a second visit. His 5 in. gauge 4-6-4 has had some small alterations since then; it now has a side-control sliding leading bogie instead of a fixed pivot and a new injector with greatly improved piping fitted. I gather he read about this in the *Model Engineer* (!!) and his injector now injects.

There were two *Zimmerman* 5 in. gauge 0-6-0Ts at work. From France M. Andre Gottlieb's engine ran on the raised track and took a share of the passenger hauling. The other ran on a circular ground level track operated by a great character, Otto Straznicky,

from Vienna. Otto enjoyed himself immensely and his colourful engine bore extra embellishments in the *Emmet* tradition. One of the bogie vehicles had a large gong underneath which could be clanged by a youthful passenger — and indeed it was very frequently. Otto's layout was a huge attraction for the kiddies. Incidentally, the overseas guests did much of the passenger carrying over the week-end, their efforts being supplemented by the Guildford club locomotives and others from home clubs.

I haven't been able to mention everything about this well attended Meet, of course, and the Guildford Club will themselves be reporting on the Traction Engine aspect of their show separately. On the Saturday evening they put on a social evening at the Carlton Hotel, Guildford, for their guests and visitors. It was obvious this Meet was enjoyed by all attending and the hosts must be very satisfied that they gave so much pleasure to their guests from far and near.

7¼" Gauge Track at Seckington Lodge

by K. E. Wilson

WHEN THE OPPORTUNITY came to move down to Devon a few years ago, it may be taken for granted that I did not stay upon the order of my going. I was fortunate enough to find a fairly sizeable house (about 42 ft. 3 in. by 26 ft. 8 in.) with an all-round garden, likewise a flat level field adjoining, that although not part of the property, certainly offered much promise. One day . . .

The main thing was that here at last was a chance of having my own track round the house. A preliminary survey of the site before the move had shown the possibilities, and it was not long after the actual move that a proper survey was made. (As a matter of interest, we arrived after a hectic day at exactly 10.45 p.m. on 31 December 1970; as near the New Year as makes little odds! Even after the journey of just over 200 miles, we unloaded the workshop then and there. There was naturally some noise, and the police soon arrived. But—they took not the slightest notice of us, merely checking the nearby Transport Café.)

At first, it was necessary to have the workshop inside the house and the fitted carpet was duly removed. At the time I was completing the second of my 47xx locos and also working on two "Saints". The television people soon found out that I was there (largely because I told them) and we had Sue Lawley along with a camera team for a short non-colour news film. This was quite fun.

However, the time soon came when once again I had my own locomotive. This is a "1366" GWR dock tank; the last of eight I have made.

I now needed a track for my own running and for testing. The "Saints" had been run on about 100 feet of track straight up the garden path, but this could hardly be called "running in" and teething troubles naturally showed up later.

About this time a local schoolboy showed great interest in working with me on locomotives, so a new outside workshop was duly designed and built. This is 29 ft. by 16 ft. inside, so we had a bit of room at last. The interior workshop was closed and handed back to the domestic authority, and the way was clear for the track.

It was found that the minimum curve would have to be 34 ft. radius; not really good for 7¼ in., and I very much doubt if the 47xx could have got round it. However, a portion of this radius was laid before the "Saints" were delivered and they managed it. with care. Later on I found that a "Castle" would get round; whether or not my nice new "King" will manage will have to be seen when the time comes. To calculate the overhang is fairly simple. but due to the fact that one is looking for small fractions of an inch amongst measurements of 34 ft., the usual log tables or slide rules are useless; I had to either do it "long-hand" or borrow a computer/calculator for the job. Whilst at it, I did a whole range of radii and a whole range of lengths of loco; the results were graphed for future use.

The formula is easy: $x = R - \sqrt{R^2 - L^2}$ where x is the overhang in inches, R is the radius of the curve in inches, and L is HALF the length of the wheelbase of the vehicle. For 34 ft. curve, with length of 25⅜ in. for a "King" driving wheelbase, this gives overhang of .197 in. Not too much, but one has to remember the reach forward of the bogie. This is less easy to work out, for the loco can slant over to one side and thus gain clearance. I have also shoved up the gauge on this curve by 3/16 in. so I live in hopes. Short of major alterations to the house (unthinkable, for it's very ancient and quite a showpiece) I am stuck with this limitation.

The present layout of the track amounts to a run of about 450 ft.; then one has to reverse all the way round. The two-road station is not the luxury that it may seem, for if we have two locos in steam the advantage

Fig. 1: The three-way point.

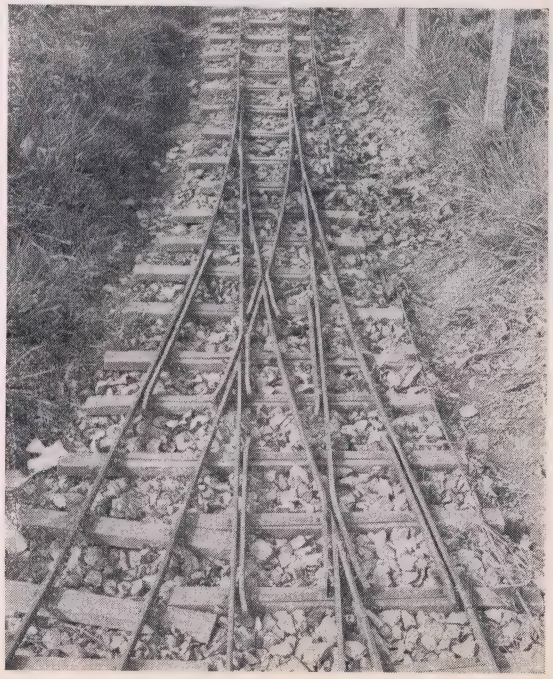


Fig. 2: The 0-6-0PT on the 34 ft. curve.

is obvious. The siding near the workshop is useful, for it has a gradient of exactly 1 in 12. More of this later.

One ambition of mine is to have a 7¼ in. track with a genuine need for a double-slip diamond crossing. They are not of course used from choice, as the simpler the better, but for future possible expansion there is a definite need; only hope that I can get it working properly. However, at present we have a three-way point, seen in Fig. 1. The main problem for this was accuracy of cutting bits to exact length from the drawing; for I could not draw it out larger than ¼ size. As it is the point is about 9 ft. 1 in. working length (blades to final frog), although the overall rail length is 12 ft. One cannot really have a frog or blade combining with a fishplate! The point works quite well, but needs a bit of adjustment to the operating mechanism. This operating mechanism enables the point to be set in either direction, but to be spring loaded in that direction. Or in other words the points can be run through trailing-wise without derailment or damage no matter what the setting.

The construction is as follows: A piece of metal about 1 in. dia. and 5¼ in. long (preferably brass or stainless steel) is turned and bored; one end is threaded. This end is later plugged by a piece threaded to suit, with a 17/64 in. hole. The "piston" is mounted on a piece of brass or stainless steel ¼ in. dia. and about 6 in. long. The two cavities labelled "Spring" have, as one might guess, a spring therein; I have found 16 SWG by ¾ in. OD to be reasonable. The device is mounted close to the operating bracket of the point; and it will be seen that movement of the extended rod (coupled to the nearby point lever) will move the switch blades over to the other side, whilst yet allowing the train to run through from the "wrong" side when the points are "trailing". It should be noted that the travel of the points lever should be somewhat greater than the needed movement (about ⅜ in.) in order that the switch blade may be held reasonably firmly against the stock rail. About 1 to 1½ in. lever movement should be adequate.

The rail used for this track is somewhat smaller than the one I described some years ago (*circa* 1967), for that type also had to serve as a portable track; this is now no longer needed and smaller section suffices. I use ¾ in. x ⅜ in. black iron. The other construction is as before, with "chairs" of ¾ in. x ¼ in. welded to the bottom of the rails at 9 in. intervals; screwed to 18 in. long sleepers of 2 in. x 1 in. sawn wood. It would be very nice to use the track supplied by Ted Martin; i.e. dead to scale, but then I am not quite rich enough!

We were lucky enough to have two sawmills nearby (they were side-by-side on the old Winkleigh aerodrome) and I got a quote of 2d each for sleepers (old money). It didn't take long to creosote them by a dipping process, and there is still quite a pile waiting use.

For some completely unaccountable reason, the designer of the house and garden had not left ready provision for the track; most unthoughtful of him. However, as we believe the house to be of the order of 500 years old then perhaps he may be forgiven. It was therefore necessary to carry out certain minor earthworks. One flower bed had to be trimmed back slightly, and another had to be completely removed sideways about 4 ft. Since these beds are up in the air by about 15 in. (small walls round same) this took a bit of digging and brickwork, but the end result is quite pleasing—Fig. 2. The tunnel is a bit of a fiddle really, as in a case like this a cutting would be used; but who could resist such a chance?

Fig. 3: The tunnel.

Said tunnel was duly designed, then after a phone call to Ted Martin was hastily redesigned; I had missed the formality of headroom when sitting on a GWR 4000-gallon tender.

The foundations of the tunnel are the two walls at the sides; built from standard breeze blocks. One acts as a retaining wall for the flower bed: the other is set about 6 in. from the boundary wall. The tunnel, it will be noticed, is on the skew; which didn't help brickwork at all. The roof of the tunnel was "shuttered" by bending up a piece of hardboard to the needed arc, supporting it with some carefully cut wooden frames. The roof was built up with breeze blocks, taking care to stagger them to get a good bond. After about a

week to set, the shuttering was moved along and the other half built. Another week, and the shuttering was removed. Feeling perhaps a bit like Brunel with the shuttering of the Maidenhead arches, I instructed that the children were NOT to walk thereon. Within the week I saw one of them doing a tribal war-dance right on the apex so I agreed that the roof was probably OK. The end walls were not too bad; I made the mistake on the first arch (the skew one) of not leaving the keystone proud; it "sets off" the end neatly. I also found out that due to the skew, bricks apart from the three or four at the peak had to be cut to horrible shapes; this accounts for the rough appearance of the outer end. The inner end was made square rather than skew; this made life a bit easier.

A local farmer had several loads of earth that he wanted to get rid of, so that took care of the covering. With thick grass over the top and a couple of hefty climbing rose bushes outside, the whole effect is quite pleasing.

I had a problem round the far side, for the electricity people came along and popped in a backstay for a new transmission pole just in the way of the track; fortunately I just managed to squeeze past. Although the plans showed that the way was clear, I must confess to some trepidation as the "permanent way" came nearer—would it—or wouldn't it? Finally (sigh of relief) it did clear; the track runs under one and over the other.

Just near here we needed a cutting; I had had to install a new soak-away for the cesspool and as anyone who has dug a hole knows—there is always a lot of earth left over. The time-honoured method of digging another hole to bury the surplus proved useless so I had to cut through. The weed-killer train is due any time!

To be continued

CLUB NEWS

News from Crewe

Members of the Crewe Model Engineering Society have recently completed the main oval of their new track. The track is of 500 ft. length for 3½ in. and 5 in. gauges and is situated in the Recreation Ground, Beech Drive, Wistaston Green, Crewe. Visitors and new members are always welcome on Sunday afternoons. The Society's Club-room at 29 Mill Street, Crewe, will be open to the public on Friday evening, 15 October, and the following Saturday and Sunday all day.

Secretary: R. A. Hawkesford, 455 Newcastle Road, Shavington, Near Crewe CW2 5JU.

CLUB DIARY

Dates should be sent at least five weeks before the event to ensure publication. Please state venue and time. While every care is taken, we cannot accept responsibility for errors.

SEPTEMBER

17 East Sussex Model Engineers. Pond Night—Boating Lake, Alexandra Park, Hastings. 7.30 p.m.

17 Romford M.E.C. Sievert Equipment—Mr. Illett, Kenneth Johns Ltd. Ardleigh House Community Centre, Ardleigh Green Rd., Hornchurch, Essex. 8 p.m

17 Stockport & District S.M.E. Talk by Mr. G. S. Snowball on his visit to South Africa. Wellington House, 324 Wellington Road North, Stockport. 8 p.m.

17 Rochdale S.M.E.E. General Meeting. Technical College. 7.30 p m.

18 S.M.E.E. Informal Meeting—Marine Topics. Marshall House, 28 Wanless Road, London SE24.

18 Harrow & Wembley S.M.E. Night Run. B.R. Sports Pavilion, Headstone Lane. 7.45 p.m.

18 Sheffield & Dist. S.M.E.E. Open day. Brincliffe Track, Omega Restaurant, Chelsea Rd., Sheffield. Boiler test certs. required. 1.30 p.m.–6.30 p.m

18 Southampton & District S.M.E. Visit to Beech Hurst Track.

18 Brighton & Hove S.M.L.E. Special train from Worthing to Kidderminster for SVR.

18 Wigan & District M.E.S. Meeting. Co-operative Guild Room, Thompson Street, Whelley. 7.15 p.m.

18/19 National Traction Engine Club. Roxton Park Traction Engine Rally. Nr. Bedford.

18/19 Golden Gate Live Steamers. Fall Run. Oakland, Ca. U.S.A

18/19 National Traction Engine Club. Ironbridge, Shropshire.

19 Guildford M.E.S. Public Open Afternoon. HQ, Stoke Park 2–6 p.m

19 Stafford and District M.E.S. "Simplex Day at County Showground"—10.30 a.m. Entries to D. A. Amey, "Windward", Boat Lane, Weston-on-Trent, Nr. Stafford, immediately.

19 Chelmsford S.M.E. Public Running. Waterhouse Lane. 2.30 p.m.

19 Southern Cal. Live Steamers. Fall Run. Sacremento, Ca. U.S.A.

19 Cambridge & District M.E.S. Model Locomotive Rally for 2½ in., 3½ in. and 5 in. gauge enthusiasts. Fulbrooke Road, Cambridge 10 a.m.

19 Kings Lynn & District S.M.E. Public Running—Walks track. 2–5.30 p.m.

19 Norwich & District S.M.E. Public running. Eaton Park track.

19 Worcester & District S.M.E. Public Running. 3½" and 5" elevated track, 3½", 5" and 7¼" ground level track. Waverley Street, Diglis, Worcester. 2.30 to 6 p.m.

20 Worthing & District S.M.E. Judging of Junior Section Competition and Bits and Pieces. Broadwater Hall. 7.30 p.m.

20 City of Leeds S.M.E.E. "Small Boat Building"—a talk by Mr. J. P. Faul. Salem Congregational Church, Hunslet Road, Leeds 10. 7.30 p.m.

21 Sutton Coldfield & North Birmingham M.E.S. Lecture on Decorative Wrought Iron Work—S. Howard.

21 Chesterfield and District M.E.S. "Loco-Construction" by Mr. J. Walker in the Canteen of the Bryan Donkin Co. Ltd. Derby Road, Chesterfield. 7.30 p.m.

22 Sutton Coldfield Railway Society. "Railways in Valencia" by Dr. Ian Frew Wylde Green Library, Emscote Drive, Little Green Lanes, off Birmingham Road, Sutton Coldfield. 7.30 for 8.15 p.m.

22 Harrow & Wembley S.M.E. Marine Meeting. B.R. Sports Pavilion, Headstone Lane. 7.45 p.m.

22 Cannock Chase M.E.S. Talk by K. Knowles "Home-made tools for modellers' workshops". Lea Hall Club. 7.30 p.m.

23 Rugby M.E.S. "A Critique of G.W.R. Loco Design" by J. Gibson. Hillmorton Community Centre, Hillmorton Road, Rugby.

23 Hull S.M.E. Talk on "O" gauge "Royal Scot" in live steam by J. Fawcett. Trades & Labour Club, Room 3, Beverley Road, 7.45 p.m.

24 Dublin S.M.E.E. General Meeting, City Quay Schools, Dublin 2. 3 p.m.

24/25/26 National Traction Engine Club. Great Working of Steam Engines. Stourpaine Bushes, Nr. Blandford, Dorset.

24/25/26 Erewash Valley M.E.S. First Models Exhibition. Parklands Adult School, Stanhope Street, off Derby Road, Long Eaton, Notts.

25 Guildford M.E.S. Night run and barbeque for members. H.Q. Stoke Park.

25 Brighton & Hove Society. Trackday. Hove Park.

25/26 National Traction Engine Club. Wimbish Steam Engine Rally. Nr. Saffron Walden, Essex

26 Southampton & District S.M.E. Last Public Running, Riverside Park. 2 p.m.

26 Malden & District S.M.E. Club Outing to Maidstone Society.

26 Bristol S.M.E.E. Public passenger carrying day. Ashton Court Track, Bristol.

26 Harlington Locomotive Society. Public Open Day. High Street, Harlington, Middx.

26 Cannock Chase M.E.S. Steam Up. Cannock Park. 2 p.m.

26 Hull S.M.E. Last Open Day of the Season. Goddard Avenue track 1 p.m.

27 Peterborough S.M.E.E. Club Meeting. Club House, Lincoln Road, Werrington, Peterborough.

27 Willesden & West London S.M.E. Quiz night. Kings Hall Community Centre, Harlesden Road, N.W.10. 8 p.m.

27 Stafford and District M.E.S. Barbecue and night run at track at Country Showground 7.30 p.m.

27 Bedford M.E.S. Steam Up Informal Meeting. Clubhouse, Wilstead. 7.30 p.m.

28 Chelmsford S.M.E. Monthly Meeting—Quiz Night. Clubhouse, Waterhouse Lane. 7.30 p.m.

29 Sutton Coldfield Railway Society. 16.5 Layout and Chit Chat. Wylde Green Library, Emscote Drive, Little Green Lanes, off Birmingham Road, Sutton Coldfield. 7.30 for 8.15 p.m.

30 Leyland, Preston & District S.M.E. Meeting. Roebuck Hotel, Leyland Cross, Leyland, Lancs. 8 p.m.

OCTOBER

1 Stockport & District S.M.E. Bits and Pieces. Wellington House, 324 Wellington Road North, Stockport. 8 p.m.

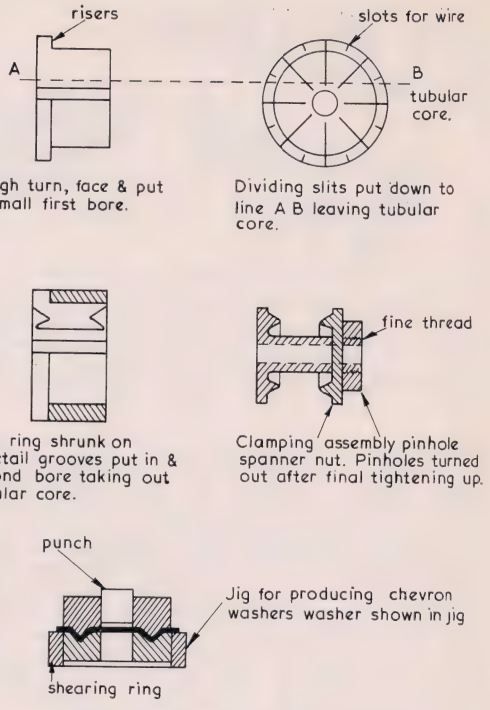
JEYNES' CORNER

E. H. Jeynes on making commutators

NOT LONG AGO, an acquaintance remarked that he would like to make a small dynamo, but the commutator seemed too much of a job for him to tackle, as he would not entertain the idea of a piece of tube split into the number of sections required, fixed on a piece of red fibre by screws. In this case, I was able to produce a small built-up commutator, together with an 8 slot armature (unwound) and a laminated set of field magnet stampings assembled but unwound, thus leaving him only to make the two endshields, and a body casting to receive the field assembly, and to wind the armature and field coils. While this helped me to dispose of some of the junk I have accumulated over the years (the commutator was made in the 1920s), it set me thinking that possibly many more people are deterred from this exercise by the same reason, therefore I think a few words on small commutator building might be of some interest.

The building of small commutators is quite straightforward really: the main material need not be copper for a small machine. brass or gunmetal will do, and if a little care is taken in the making, it will probably be a better job than some of the commercial moulded ones I have seen. Having decided upon the overall dimensions, get a blank a little larger than the finished size of the risers (to which the armature connections are made), and wide enough to allow facing up each side; set it up in the chuck, and face the one side, then rough turn the risers and running surface, and put the first bore through it so that it can be mounted on a mandrel to be divided into the number of segments required; the cutting can be done with a narrow slitting saw, or even by a junior hacksaw suitably guided: care being taken not to cut below the line A-B; the slots for the armature coil connections can be put in at the same time, and it makes the job easier if these are tinned, before the commutator is finish turned. Sheet mica a tight push fit in the slits is cut into strips, and anointed with Araldite, inserted into the slits, and left for several days to season. The mica and commutator running surface and risers are lightly skimmed and a steel ring heated and shrunk on over the running face; this will hold the segments firmly in place while the end dovetailing grooves are put in, and the second bore put through, this being done with a small boring tool until the inner side of the mica separators are visible.

A jig is required to produce the chevron shaped washers (micanite being the material for these, heated during the pressing). which also trims the outside diameter, and punches the central hole at the same time, allowing to cool with the pressure still on (the vice is handy for this job). The sleeve upon which the whole assembly is mounted is turned with the one end clamping face integral. bored to fit the shaft, and screwed a fine thread on the opposite end. The second clamping disc is bored a sliding fit on the sleeve, and a suitable nut to apply the pressure endways; a circular nut with holes for a pinhole spanner is suitable; this can be reduced in thickness after tightening well up, until the pin holes are turned out. The two micanite washers are next anointed with Araldite, the first one placed on the sleeve, which is then pushed into the body of the commutator, the second micanite washer is then placed in position and the loose clamping disc slid on


risers
slots for wire
A
B
tubular core.
Rough turn, face & put in small first bore.
Dividing slits put down to line A B leaving tubular core.
fine thread
Steel ring shrunk on dovetail grooves put in & second bore taking out tubular core.
Clamping assembly pinhole spanner nut. Pinholes turned out after final tightening up.
punch
Jig for producing chevron washers washer shown in jig
shearing ring

SMALL BUILT UP COMMUTATORS
rough sketches, not to scale. 8 section

to the sleeve, and the nut tightened well up: the whole is then left for a day or two, preferably in a warm place. The steel ring is then gingerly turned off, and the brush surface and the risers finish turned and polished. If the job is Megger tested, it should give an almost infinity reading between the segments, and between the segments and sleeve.

In the past, I have seen sketches of commutators in section, to show the dovetailing construction, and some are quite poor design, in which the commutator is greatly weakened during progressive re-turning, and there is a possibility of the risers parting company with the bars, also the type having one side of the clamping Vee parallel with the axis leaves one side of the micanite not under pressure, which allows ingress of damp. Some designs show the second clamping disc integral with the nut; this is not good either, as the action of screwing up may easily damage the micanite chevron washer.

Finally, I would say that I have seen the effects of a burst commutator on full-size machines, not a very frequent thing these days of Morganite brushes etc.; whereas with the old copper gauze brushes, the wear of the commutator was very rapid.

NEW "MODEL ENGINEER" DRAWINGS

LO.944. Boiler for 5 in. gauge LMS Rebuilt Royal Scot 85p

LO.945. Boiler for 5 in. gauge LMS 5XP class 4-6-0 85p

LO.946. Stanier 4000-gallon tender, 5 in. gauge 85p

TE.11, Sheet 17. Allchin traction engine — Injector and Lubricator 85p

The Editor welcomes letters for these columns. He will give a Book Voucher for £3.00 for the letter which, in his opinion, is the most interesting published each month. Pictures, especially of models, are also welcomed. Letters may be condensed or edited.

Injectors

SIR,—In the very good article on "Miniature Live Steam Injectors" in *M.E.* No. 3536, Basil Palmer credits Bill Carter with the method of burnishing or spinning ball valve seats. I do not think Bill Carter ever claimed originality for this method in his writings.

As a matter of fact, the first time this information appeared in *M.E.* was in "Postbag", over my name; *M.E.* No. 3435, p. 197, pre-dating Bill Carter's article by a considerable period. Credit for this excellent method of generating a ball seat belongs to Cliff Blackstaff, of Victoria, B.C. This was in a series of articles that appeared in the U.S.A. magazine *The Miniature Locomotive*, about 25 years ago.

However, there's a difference in Cliff Blackstaff's method and mine. He made the burnishing tool from the solid, turning and polishing the spherical radius in the lathe. A tricky operation. My method, given in "Postbag", I figured was an easier way of arriving on time at the same platform. I can just picture friend Jerry Penrose with both ears to the ground! It's good to see, from contributions in *M.E.*, that this superior method of forming a ball seat is meeting with approval of other model engineers.

Reading through my contribution to "Postbag" regarding ball seats, Dr. Philip Lowe of Queens University in the City of Kingston, Ont., thought to try burnishing the ball seats in oxygen equipment at the General Hospital there. There was a noticeable reduction in oxygen leakage in equipment so modified.

While the late Eric Rowbottom rightly draws attention to the poor practice of biffing a ball to form a seat, his method of forcing a ball down by means of screw pressure has little to commend it, especially in the case of injector air valves. Reason: the heavy pressure needed on the ball in forming the seat is almost certain to distort the injector barrel bore—a hazard to be avoided at all cost. Same thing applies to a ball clouted with a brass punch.

A point that Basil Palmer could enlighten us on, is Mr. Rowbottom's statement on p. 440 of *M.E.* No. 3536, "that the division space . . . is always full of water" (between two halves of combining cone?). I have always presumed that this space was under vacuum while the injector is working. If so, then any water present would be picked up by the mixing cone? Otherwise, could air be drawn in by a leaking air valve?

A feature in the combining cone shown in Basil Palmer's article is worthwhile avoiding, in my experience of these little injectors, and that is the two very fragile snouts to the two mating halves of these divided cones. One may have reason to remove or adjust the position of these cones during the life of the injector, maybe more than once. So then what happens to these snouts?

The 2/10 thou. interference on the O.D. of these cones is of course a counsel of perfection — rarely attained, may I add. Few will possess bore gauges to ensure this fine work.

I have as a keepsake, a Kennion injector that was purchased by an old friend on a visit to England. He never could get it to work, and it then came into my possession. On mounting same on my locomotive, it picked up like nobody's business, with the merriest chirp you ever heard. It feeds from 120 lb. down to about 40 lb., with a little cut down of water at low pressures.

To make sure, I have just re-examined the combining cone for the presence of "snouts". Those cones are flat ended, as they should be, at the point of division.

It would seem to me that the divided combining cones provided with snouts offer little or no advantage in actual working. Several injectors that I have made with this feature cannot be distinguished in performance from the older Kennion production.

Picton, Ontario — George Hill

Ornamental Lathes

SIR,—I don't think Mr. Hadden-Deering has quite appreciated the fundamental reasons for the concern of Mr. Davies (and others) at the idea of machining even one large iron casting on an Ornamental lathe designed mainly for turning Ivory. It is true that the shoulder against which the chucks are screwed is a fair size, but the absence of any register means that the truth of any chuck—on which ALL Ornamental work depends—relies on the truth of the mandrel nose thread. If this is distorted the chucks will run awry.

This thread, on all Holtzapffel and Evans lathes (and some others), is about 0.798 in. dia., screwed 9.45 t.p.i. and the thread is a fine angle (about 50 deg.) with negligible radius at the root. The core diameter is *less* than 0.6 in. To put this in strength terms, if made of the same material a Myford mandrel nose is FOUR times as stiff in torsion. And that is a 3½ in. lathe compared with the O.T. lathe's 5 in.

But this is not all. If the machine is an "antique" (i.e. over 100 years old) then the mandrel will almost certainly be made of wrought iron, casehardened ("steeled") or with hard sleeves in way of the bearings, compared with the alloy steel of a modern lathe. Taking this into account as well, the strength ratio between Mr. Hadden Deering's 5 in. O.T. lathe and a modern 3½ in. machine is about one to ten. Even if the mandrel is made of steel throughout the ratio will be about one to eight. Add the fact that the risk of thread distortion is vastly augmented by the fine angle and the sharp root, and danger is increased. This is not to say that one must never use such a lathe for ironwork, but the risk must be clearly appreciated; getting under the skin of the rim of a large flywheel could put a shock load on the mandrel which might spoil it for any future Ornamental work, quite beyond remedy.

On a lighter note, the effect of gravity on Mr. Hadden Deering's chucks, even when expressed in the units of Henry VIII, should be seen in proportion! The normal 4-jaw on a current 5 in. lathe weighs over 35 lb. (about one-third of a hundredweight) and that for a 3½ in. lathe is heavier than his 2-jaw or the Rectilinear Chuck. (The latter is never used in rotation, by the way; it is really an indexable vertical slide.) In fact, the 9 in. faceplate on the Myford weighs more than the usual Ornamental Chucks. The weight

hanging on the mandrel nose, as a dead load, does have to be considered, of course, but it is the "live" load due to the cutting forces which really matters. The fact that these lathes were designed to be driven by gut bands, or in later days, 3/16 in. leather belts, gives some idea of the cutting capacity which the makers had in mind.

Finally, Mr. Hadden-Deering is to be congratulated on appreciating the scope of his machine, in using it to cut a 6-start worm. But why use a Potts spindle when one of his photos shows a first-class "Birch" cutting frame?

Kendal. T. D. Walshaw

Copper Boilers

SIR,—May I pass some comments on the remarks by Mr. F. Horseman? He asks if any copper boilers have gone brittle.

It is a good question; I think a lot depends on the type of copper used. Ordinary tough pitch copper is made in three grades. High conductivity, high thermal and electrical conductivity, best select copper in which the impurities are slightly higher than in the high conductivity copper; the last is alright for most applications, but not advisable for electrical uses.

Arsenical copper contains arsenic amounts up to about 0.5%, arsenic being added to increase the ease of working the metal, hardening the copper, and making it useful for most purposes. All the above grades of copper contain a small amount of oxygen, in the form of Cuprous oxide. The oxide is not harmful because it is in the form of spheroidical particles distributed in the mass of copper.

The danger occurs when copper is heated to the region of melting point. The cuprous oxide forms a Eutectic with the copper and this Eutectic migrates to the grain boundaries, and impairs the mechanical property of the metal. Also the possibility of a reaction might occur between the oxide and gases of the welding flame, reduction of oxide to metallic copper producing water vapour within the metal, which will cause intergranular cracks, porosity, etc. Since the oxide is made up mostly of copper, it means that the amount of oxygen need only be small for a considerable amount of Eutectic. So a small amount of oxygen can be harmful when it is welded, etc.

To overcome these problems a grade of copper known as deoxidised copper has been introduced. The difference is a small amount of deoxidising element, phosphorus, has been added. This unites with the oxygen to form volatile oxide of phosphorus which evaporates, leaving the metal free from oxygen.

At the same time, a small amount of phosphorus is left in the metal. to act as a deoxidiser in heat welding operations which results in reliability, strength, durability, etc. Two of my locomotive boilers are made of the above copper, and I have no fears, so it would appear that deoxidised copper is best if one can obtain it. One reads of boilers still steaming after 20 years. so copper must be safe enough.

LBSC used to say heat and plenty of it, for brazing. TRUE, but one can have too much of a good thing. One of the reasons why silver solder is used so much.

Darlington. J. H. Gladden

Ball Valves

SIR,—I was most interested to read of Mr. Horseman's aversion to ball non-return valves in "Postbag", *M.E.* No. 3541. Having just completed a *Springbok* as a family effort, I too have become disenchanted with the performance of ball type non-return valves, particularly those using so-called rustless steel balls. This type of valve seems to be prone to "sticking" initially and "dribbling" thereafter. According to the position used on *Springbok,* malperformance of these valves has resulted to date in:

(i) Bending the tender pump handle—valve stuck.
(ii) Filling the tender with hot water during a day's running—valve dribbling.
(iii) Total failure of cylinder lubrication by allowing high pressure steam back into the oil container of the mechanical lubricator.

All of these faults were found to be directly attributable to non-return valves using rustless steel balls and brass or gunmetal seatings. It is interesting to note that no trouble has been experienced with valves using bronze balls. All valves were sound when tested to above 200 p.s.i. before fitting to the locomotive. Another problem was severe corrosion pitting of the rustless steel cores of the blowdown valves, the seating again being gunmetal.

Do other model engineers have similar troubles to these, or are we going wrong somewhere? I should be very interested to see a sketch of Mr. Horseman's pop wing valves published in *M.E.* and to hear other readers' comments on their experience with "rustless" steels.

Shefford, Beds. R. C. Bavister

BOOK REVIEW

"Gresley and Stanier—A Centenary Tribute"
by John Bellwood and David Jenkinson
Published by H.M. Stationery Office, Room C46, Atlantic House, Holborn Viaduct, London EC1P 1BN. Price £3.

This is the first book published by the National Railway Museum and fittingly marks the Centenary of two great locomotive engineers.

All the locomotives of both Gresley and Stanier are described, together with their rebuilds.

Gresley's rise to pre-eminence was almost meteoric and his fame was unquestioned, especially in the period 1935-39. Apart from his fine locomotives, he will be long remembered for his clever designs in the rolling stock field—double-bolster carriage bogies, articulation, standard goods brake vans—to mention only a few.

Stanier's progress, on the other hand, was slower and less flamboyant and it was not until he had left the Great Western that he really came into his own. But Stanier was given a most formidable task when he was appointed to the L.M.S. By the outbreak of War in 1939, he had improved the locomotive department of the L.M.S. out of all recognition.

The work is well produced and very well illustrated, and includes some interesting photographs of Crewe and Doncaster works and Derby drawing office.

R.M.E.

SOME WORKSHOP DRAWINGS

W.E.1.	*6 in. bench grinder*	*75p*
W.E.2.	*¼ in. sensitive drilling machine*	*75p*
W.E.3.	*1½ in. universal swivelling bench vice*	*75p*
W.E.4.	*Sawing and filing attachment for the lathe*	*50p*

MODEL ENGINEER HOT AIR ENGINE COMPETITION

A COMPETITION to encourage the design and building of hot air engines will be held at the 1977 Model Engineer Exhibition. Prizes have been generously donated by Mr. A. N. Clark, of Ryde, Isle of Wight, and Professor D. H. Chaddock, C.B.E., has kindly consented to act as Judge.

The only conditions are as follows:

1. The hot air engine entered must be the unaided work of the competitor.
2. No entry will be accepted from a professional model maker.
3. The decision of the Judge/s shall be final.
4. The swept volume of the working cylinder/s shall not exceed 5 c.c.
5. The power output of the engine will be measured by a friction brake with a lever arm and weights.
6. Speed measurement will be by revolution counter and stop watch.
7. All engines entered must have a standard output shaft 5/32 in. dia. x ¾ in. (approx.) long.
8. Competitors will have the option to run their engines themselves, under the scrutiny of the Judge/s.
9. Competitors should submit with their entry notes for the Judge/s regarding lubrication, firing, warm-up procedure, minimum and maximum revs. at which the engine should be run.
10. The duration of each run shall be left to the discretion of the Judge/s.
11. Winners will be required to submit details, a photograph and drawings of their engines for publication in *M.E.*
12. Although every care will be taken, the organisers cannot be held responsible for any accidental damage to the engines.
13. Details of entries must be sent to the Exhibition Manager, M.A.P. Ltd., not later than 1 December 1976.

PRIZES:

1. A first prize of £50 would be awarded for the hot air engine developing the highest horsepower.
2. A second prize of £25 would be awarded for the engine developing the second highest horsepower.
3. There would be a consolation prize of £10 for the engine (other than those awarded the 1st and 2nd prizes), which displayed the highest standard of workmanship.
4. There would be a second consolation prize of £10 for the engine which displayed the most original design work.

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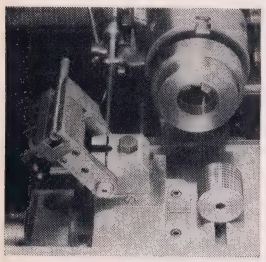

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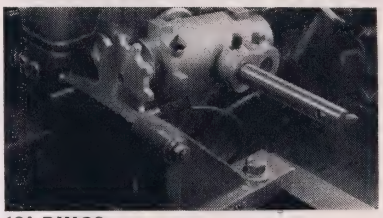

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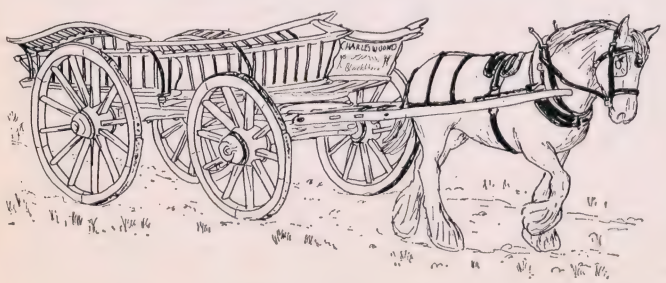

The Oxfordshire waggon is usually considered the most attractive of English farm vehicles. This example dates from the early 1800's, and shows all the traditional features of the village-made waggon. It is now in the care of Oxford County Museum. The plans are on 4 sheets, plus a sheet of photographs. Prices are £2.70 for ⅛ scale, £1.90 for 1/12 scale, including postal tube and illustrated catalogue. For catalogue only please send 3 x 6½p stamps.

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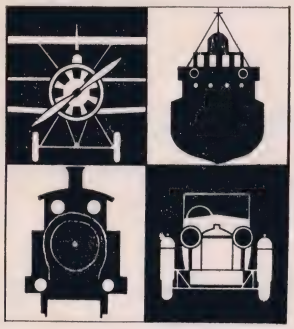


46th Model Engineer Exhibition

JANUARY 4-15th, 1977

(Not open Sunday)

at Wembley Conference and Exhibition Centre

LOCOMOTIVES, BOATS, AIRCRAFT, TRACTION ENGINES MILITARIA, WOODWORK, CRAFTS

The 1977 Exhibition moves to the brand new Wembley Conference and Exhibition Centre, right next to Wembley Stadium and the Empire Pool. It will be on two floors, each of which is greater in area than the total space available at our home for the last few years, Seymour Hall, and there will be over 100 trade stands and many society and association displays.

Conveniently situated just off the North Circular Road, between the ends of the M1 and M4, there is car parking for 5,000 cars (or 2,000 coaches) and there is the chance to combine a visit to the Exhibition with the ice show at the Empire Pool or the Christmas show at the new 2,700 seat theatre. Catering facilities are excellent—the Bridge Bar, in the Exhibition, seats 500, and there will be a snack bar and restaurant. Even if twice the numbers of previous years attend on any one day, there should be no real crush.

On the upper floor will be most of the engineering and marine stands and exhibits, including the S.M.E.E. workshop and track, plus a Gem Craft section (popular with the ladies!) while downstairs will be military modelling and wargaming, aircraft, the central display area (electric aircraft, R/C cars and tanks, live steam traction engines, etc., etc.) plus, for the first time, a special Woodworker area, with famous tool suppliers, demonstrations, competition entries etc.

Throughout, demonstrations are planned, including lathework, brazing, milling, and other workshop practices, lapidary, enamelling, wargames, miniature weapon-making, cart making, wood turning and machining, boatbuilding—a real feast of how to do it.

COMPETITION CLASSES

Entries are invited in the following categories:

A	Locomotives. 2½ in. gauge and over.
A1	Locomotives—to any L.B.S.C. design 2½-5 in. gauge (including steaming).
B	Locomotives. In gauge 1 and 0.
BA	Locomotives. In gauges smaller than 0.
C	Rolling Stock and Accessories. Gauge 1 and 0 or larger.
CA	Rolling Stock and Accessories. Gauges smaller than 0.
D	Steam and Motor Ships of any period. (Non-working).
E	Power Driver Boat Models. (Complete with power plant). Scale or Freelance.
F	Sailing Ships of any period. (Non-working).
G	Working Yachts and Sailing Ships.
H	Hydroplanes and Speedboats.
I	Miniature. Length of hull not to exceed: 9 in. for ⅛ in.—1 ft. scale or larger; 10 in. for 1/16 in. scale; 12 in. for 1/25 in. scale, 15 in. for 1/32 in. scale. No limit for smaller scales.
J	General Engineering Models (including stationary and Marine Engines).
K	Internal Combustion Engines.
L	Mechanically Propelled Road Vehicles (including tractors).

(J, K, L: working models)

N	Tools and Workshop Appliances.
O	Engineering Scale Models (Non-working).
P	Scenic and Representational Models (including Architecture).
Q	Horological, Scientific and Optical Apparatus.
R	General Craftsmanship—not otherwise classified.
S	For any type of model (other than military) or mechanical work by a junior under the age of 16 by 31 December, 1976.
AA	Flying models of all types; (a) free flight, (b) control-line and (c) radio control.
AB	Scale flying models of all types, rubber, glider, power, control-line or radio control.
AC	Scale non-flying models.
AF	A piece of radio control equipment built to a design published in Radio Control Models & Electronics, Aeromodeller or Model Boats, from a commercial kit, or of original design.

MA, MB, MC, MD, MJ1, MJ2: Classes covering miniature figures, dioramas, artillery, etc, detailed on official entry form.

Junior Prize additional in each class with three or more entries. (Under 16 on 31st December, 1976).

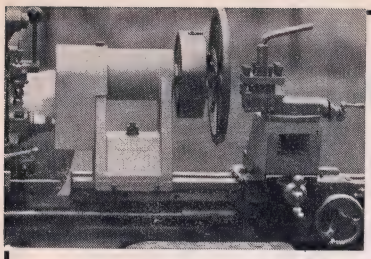
Woodworker Section: WA Cabinet making; WB Wood carving; WC Wood turning; WD Musical instruments; WE Marquetry; WF Fretwork, pyrography, miscellaneous

Entries for these classes should use special entry form in September or October 1976 issues of Woodworker magazine. Note that these particular classes are open to both amateur and professional craftsmen.

In addition, there is a competition for hot air engines, a special classification for model boats built from a kit, and a one-subject Colonial 1857-1900 military modelling class. Details of all these in the appropriate magazines and/or on the entry information forms, available after mid-July. Loan (non-competitive) entries will also be considered.

This is *your* exhibition as much as ours, and we hope to have the favour of your full support—lots of models, volunteer stewards/demonstrators etc. to make this first major exhibition at the new venue a resounding success which will further the interests of modellers nationally.

COMPETITION ENTRY CLOSING DATE IS OCTOBER 18th, 1976



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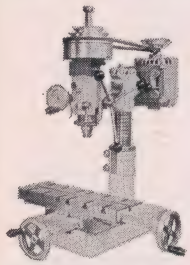

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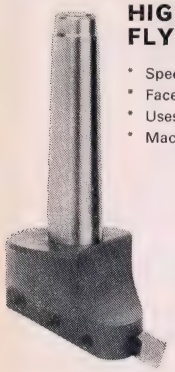

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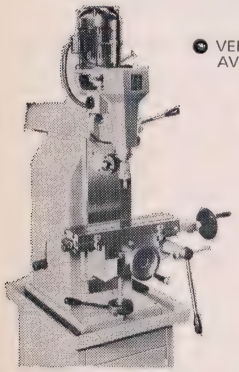

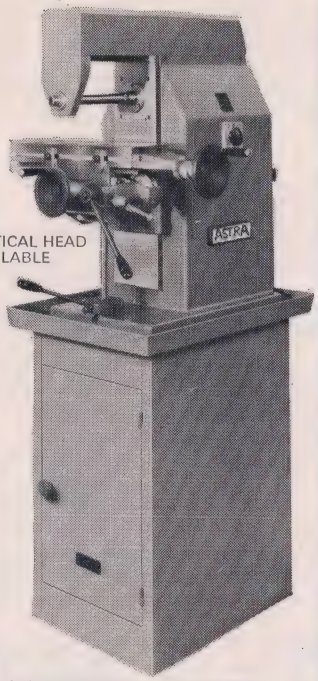

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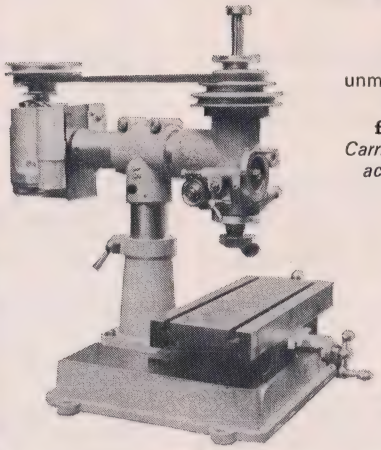

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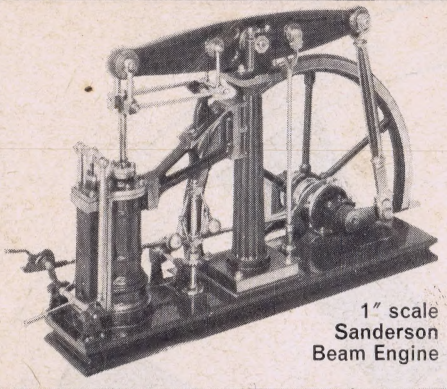

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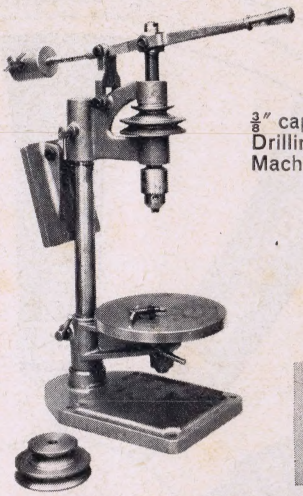

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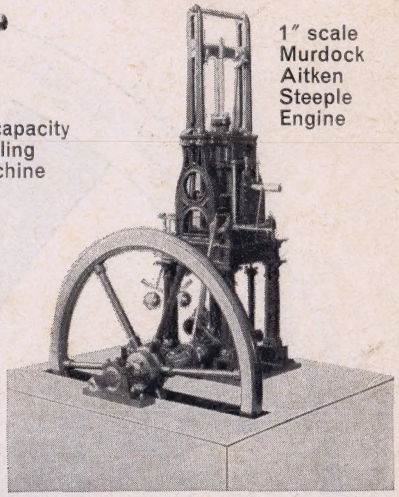

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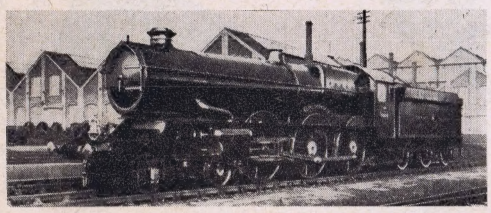

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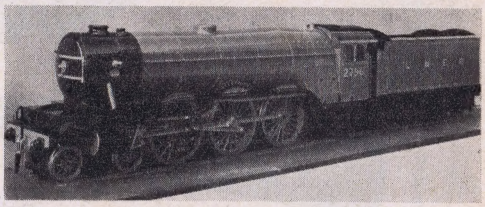

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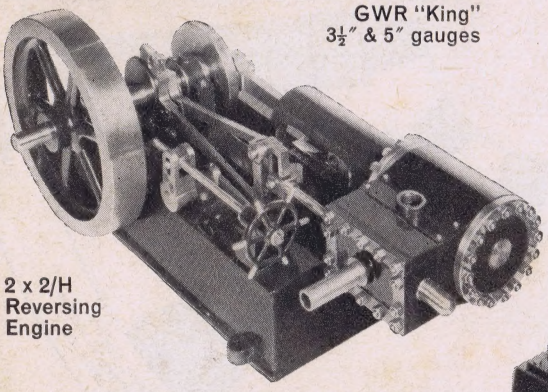

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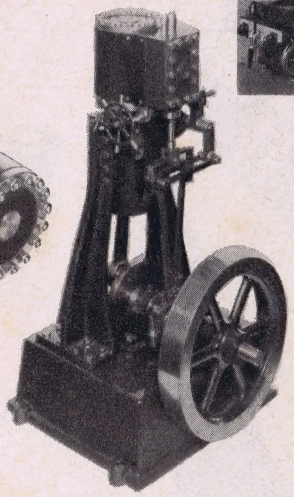

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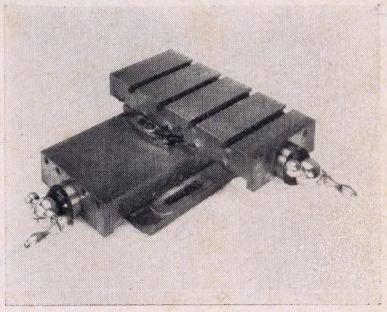

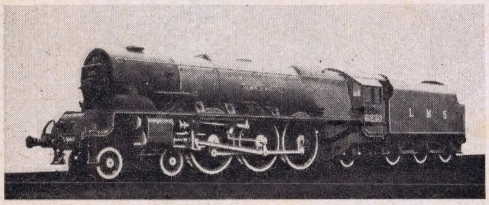

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